AQUILA

A MAGYAR MADÁRTANI INTÉZET

(AZ ORSZ. KÖRNYEZET- ÉS TERMÉSZETVÉDELMI HIVATAL
MADÁRTANI INTÉZETE)

ÉVKÖNYVE

ANNALES INSTITUTI ORNITHOLOGICI HUNGARICI

International Waterfowl Research Bureau
Symposium on Population Ecology of Geese
Debrecen, Hungary, 26–30 october, 1981

1982

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HERMAN OTTÓ

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International Waterfowl Research Bureau

The Symposium on "Population ecology of geese"

For many years now, IWRB's annual meeting has included a symposium on a scientific subject. Thus in 1972 at Brno, Czechoslovakia, the subject was "Rational Use of Waterfowl Resources"; in 1973 at Warsaw, Poland, "Waders"; in 1975 at Stockholm, Sweden, "Sea ducks"; at Alushta, USSR in 1976 "Mapping of Waterfowl Distributions, Migrations and Habitats"; at Gwatt, Switzerland in 1977 "Feeding Ecology of Waterfowl"; at Carthage, Tunisia in 1978 "Colonially-nesting Waterfowl"; while at Sapporo, theme of a symposium in Hungary, reputed throughout the world as a major staging-area for migrating geese, some aspect of goose biology was an obvious choice, the more so as geese had not been covered in recent IWRB symposia.

The subject chosen was "Population ecology of geese". The aim behind this choice of subject was to clarify the present size of goose populations, and, more important perhaps, to explain the reasons for changes in numbers. Special attention was devoted to three geese of particular interest to Hungary: Greylag Goose *Anser anser* because it is common and increasing, Lesser White-fronted Goose *Anser erythropus* because, though formerly common in Hungary, it is now rare and decreasing, and Red-breasted Goose *Branta ruficollis*, because, though the world population is small and limited in range, its occasional appearances in Hungary are becoming somewhat more frequent. The other special aim of the symposium was to attract contributions on population ecology of geese from central and eastern Europe, areas of particular interest to goose specialists not only in Hungary.

It will be apparent from the papers published in this volume that several *Anser anser* populations are increasing, though there is concern about Spanish wintering-grounds and there is insufficient information about this species in parts of eastern Europe. *Anser erythropus* obviously arouses considerable concern, and there is a very urgent need to discover and study its wintering areas in southern Europe or western Asia. *Branta ruficollis* now seems to be holding its own. The Symposium also drew special attention to the reduced numbers of Bar-headed Goose *Anser indicus* and Greenland White-fronted Goose *Anser albifrons flavirostris*. For all geese, it is clear that habitat conservation, whether in wintering areas, staging-areas (especially in spring) or in the breeding ground, is the major priority.

The International Waterfowl Research Bureau (IWRB)

IWRB is an international non-governmental organization, established in 1954 "to stimulate and coordinate, on the international plane, research and conservation involving waterfowl and wetlands". It operates through national delegates and research groups, both of which are represented on the Executive Board. At present 32 countries appoint national delegates, though there are informal contacts with very many more. There are 14 research groups, some of them coordinating censuses or detailed research on particular species groups, some devoted to more general topics such as Feeding Ecology, Hunting Rationalization or Wetland Management. IWRB is financed by contributions from member states, by a grant from World Wildlife Fund and by sales of its publications; much of its work however is carried out by ornithologists working in their own time or in time made available by their employers for IWRB activities. IWRB Headquarters, after being first at the British Museum, London, then at the Tour du Valat, Camargue, France are now in Slimbridge, England, where Prof Matthews, the Director of IWRB, is Director of Research at the Wildfowl Trust.

IWRB has been closely connected with the "Ramsar" Convention (Convention on Wetlands of International Importance, Especially as Waterfowl Habitat) since its inception. Governments which become Contracting Parties to the Convention list at least one wetland of international importance in their territory and accept a general obligation to make wise use of their wetlands. By November 1981, 31 states were Contracting Parties and had listed 234 wetlands covering seven million hectares.

The Hungarian organizers

The Symposium, together with IWRB's XXVIIth Board Meeting was held at the Hotel Arany Bika, Debrecen, from 26 October to 1 November 1981. Arrangements for the meeting were in the capable hands of the National Authority for Environment Protection and Nature Conservation (Hungarian initials OKTH; Head office: Költő utca 21, 1121 Budapest XII.). Mr. Zoltan Rakonczay, Vice President for OKTH, attended much of the meeting, the symposium, and the study tours. Dr. István Sterbetz, of the Hungarian Ornithological Institute (Madártani Intézet, address as OKTH) was Honorary Chairman of the Symposium, as befitted his great expertise and experience in goose and other studies east of the Danube. Members of the Hungarian Ornithological Society (Magyar Madártani Egyesület) also took part.

During the study tours, the participants visited a number of major goose areas in eastern Hungary, many of them listed under the Ramsar Convention. Special mention should be made of: the Hortobágy National Park, visited by horse-drawn carts on 28 October; of the Kardoskút Reserve on 31 October, where magnificent views were obtained of some 6000 Cranes *Grus grus* as well as of flocks of White-fronted Geese *Anser albifrons* and some Lesser White-fronted Geese *Anser erythropus;* and of the Kiskunság National Park where a flock of 49 Great Bustards *Otis tarda* bid delegates farewell on 1 November.

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I. THE EXTINCT ANCESTOR OF *ANSER ANSER* IN EUROPE

D. Jánossy

Our knowledge of any fossil birds is very imperfect and documentation upon the origin of the waterfowl of the Pleistocene, the period covering the last million years, is especially meagre. The reasons for this are chiefly the special circumstances of fossilization in this period: most localities are connected with karstic phenomena (caves and fissures), in which mammal faunas dominate, bird bones are very subordinate and the few found chiefly originate from non-aquatic birds.

During a revision of the Pliocene and Pleistocene bird remains from Hungary as well as different localities in Europe, I found to my great pleasure in the material of some localities, not very close together geographically though geologically very near to one another, a good documentation of aquatic bird remains. One is a lime-mud connected with a travertine (Hill of the former Royal Castle in Budapest), the other ones are lacustrine clays (such as the oldes archeological site in temperate Europe, Prezletice, near Prague; Voigtstedt in Thuringia, Germany; and finally Ambrona, near Madrid, central Spain) (*Jánossy*, 1982).

These localities yielded bones of grebes and cormorants, six or seven different duck species, some birds of prey such as *Falco tinnunculus* and a fossil form of *Haliaetus albicilla,* rails, coots, cranes and shore birds, and also bones of a large goose. The aquatic bird fauna of these inland lakes was (as appears from this enumeration of the chief forms) very near to that of to-day, although it may be supposed, as will be seen later, that most of these species were extinct ancestors of the closely related forms living today.

Let us now look at the bones of the goose. A comparison of the remains with skeletons of geese living today in Europe shows a close resemblance with those of *Anser anser*, although they seem to be much larger.

Looking for analogies in the geological past, we can establish the following: although we know remains of aquatic birds such as flamingos, loon-like forms, cormorants and shorebirds, beginning with the Cretaceous period (more than a hundred million years ago) waterfowl remains are known only from the Eocene, about 60 million years before the present. The origin of this group of birds is still problematic, although some recent investigations suggest they are descended from ancient shorebirds. After all we know only altogether seven extinct species of geese from the Upper Miocene (10 million years ago), Middle Pliocene (2 – 3 million years) and Lower Pleistocene. However, all hitherto described forms are considerably smaller than the recent European forms, or their proportions are different from those of living ones (*Lambrecht*, 1933, *Wetmore*, 1951).

Thus, the only real comparison possible was with the living forms of our territory. Considering that the osteology of the recent geese of temperate Europe is very well known, due to the dissertation of *Bacher* (1967) at the Veterinary University of Munich, we can compare our remains with a wide variation of recent species. The investigation of a statistical material showed that the bones of *Anser albifrons*, *A. fabalis* and *A. anser*, can hardly be separated from one another in their range of variation. Measurements of the bones of about 150 specimens of the above mentioned species show a wide overlap. However, if we compare the whole range of variation of some bones of these geese with the measurements of fossil bones, we find that the size of the extinct form was much larger than any recent European species of the genus *Anser*.

Thus, we have before us the remains of a bird the size of the sturdiest domestic goose of today, which seemingly was widespread in the waters of the whole of Europe half a million years ago. It is worthy of mention that this *Anser* species, for which I propose to give the name of a new species for science *Anser subanser* (*Jánossy*, 1982) is the single species hitherto known from the genus in the period mentioned in our continent. This may of course be due to our insufficient knowledge of the extinct waterfowl as a whole.

We know very few species of water birds at all, because the differences in details of bones between living and extinct forms of birds are in general very delicate and hidden. The case of the goose made known in this short lecture, is a very nice example in which an extinct form can be statistically distinguished from recent ones. It is to be hoped that in future, by finding much more material from this fascinating group of birds, we can describe more exactly the bird life of our immediate past.

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II. THE STATUS OF THE GREYLAG GOOSE *ANSER ANSER* IN BRITAIN

M. A. Ogilvie

The Greylag Geese of Britain fall into three categories.

1. Indigenous population

This is confined to the north-west of Scotland and the Outer Hebrides and is the remnants of the formerly more widespread stock which bred in many areas of Scotland and northern England some hundreds of years ago. It probably numbers between 1500 and 2000 individuals and has been thought to be declining for many years. However a recent spread and increase of breeding pairs in the Outer Hebrides may signal a change.

2. Introduced flocks

Greylags have been introduced, by landowners and shooters, into many localities in Britain. The largest population, of perhaps 1000 birds, is in south-west Scotland and dates back about 50 years. Other, smaller flocks, can be found very widely in southern and eastern England, the north-west, Wales and some other Scottish localities. They may together total another 2000 birds.

3. Icelandic population

Virtually the entire breeding population from Iceland winters in Britain. A few hundred probably stay back in Iceland, and between 750 and 1000 winter in Ireland. The remainder are concentrated in Scotland, particularly the north-east and east central areas. They arrive towards the end of October and are censused annually on the first or second week-end of November, at the same time as the Pink-footed Goose *Anser brachyrhynchus* with which they often consort. Amateur bird-watchers carry out most of the counting, concentrating on the roosts. I make counts in areas with few bird-watchers, and also make age-ratio counts to assess breeding performance.

Figure 1 sets out the totals counted in Britain since 1955, together with the percentage of young found. There has been a three-fold increase in the period, very steady between about 1960 and 1973, followed by a sharp decline related to years of poor breeding, with a concluding upsurge to the present 90 000.

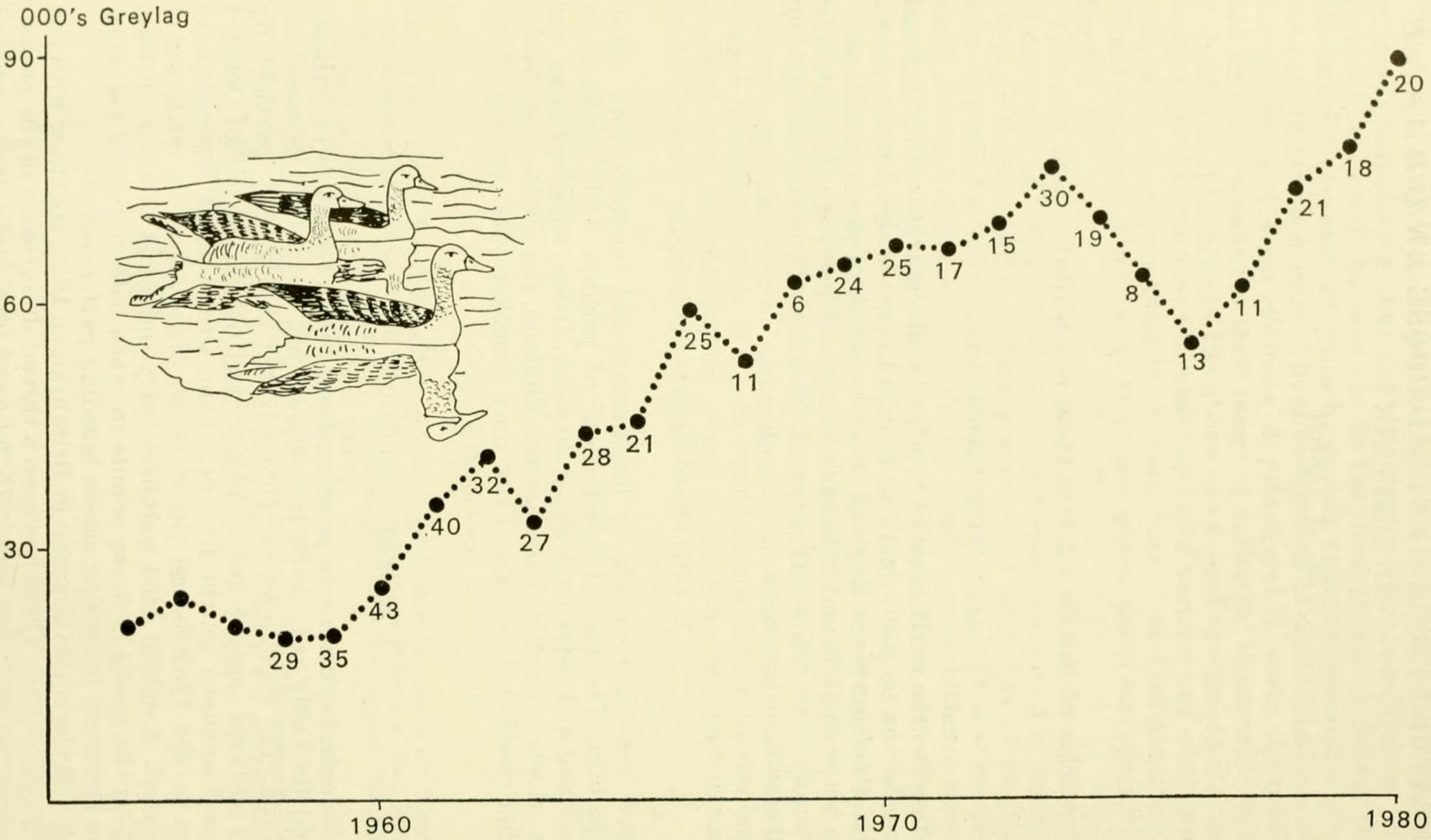

Figure II/1: Numbers in Britain, 1955 – 1980. Figures on graph-percentage young (not aviable before 1958)

Boyd and Ogilvie (1972) and *Ogilvie and Boyd* (1976) have dealt with this increase and the associated variations in recruitment and mortality in some detail. In summary, there has been a general contraction of the wintering range at the same time as the growth in numbers, both linked strongly with increase in the amount of barley, potatoes and improved grassland being grow in Scotland. This is much the same picture as for the Pinkfoot (see paper in this symposium). Again, similar to the Pinkfoot, the average breeding success of the Greylags has fallen steadily as the population increased. However there is not thought to be the same pressure on breeding places in Iceland as there is for the Pinkfoot, so the reason remains obscure.

Ogilvie and Boyd (1976) suggested that numbers in the period 1975 to 1980 would grow more slowly than they actualy did, and their statement that the population would probably not grow much above the then current levels should be revised. There seem to be fewer constraints on further growth of the Greylag than on the Pinkfoot. However there are pressures coming from agricultural interests in Scotland to allow licensed shooting to prevent damage to grass and crops in the spring, between the end of the shooting season and the birds' departure in late April. Unlike the Pinkfoot, the Greylag is exposed to some shooting in Iceland, though this is currently light. It could increase, however, as a way of reducing agricultural damage there.

In autumn 1979 the Greylag became Britain's most numerous goose species, overtaking the Pinkfoot which had for long held that distinction. Although the Pinkfoot was again more numerous in autumn 1980, given the generally slightly higher average breeding success of the Greylag and its very slightly lower mortality rate, it can be forecast that the Greylag will soon overtake the Pinkfoot once more and then very probably stay in front.

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III. MOULTING *A. ANSER* ALONG THE GOTLAND COAST

L. von Essen – R. Beinert

The investigation was carried out by Rolf Beinert and Lambart von Essen, Swedish Sportsmen's Association, with financial support from the Research Committee of the National Swedish Environment Protection Board.

Summary

Every year in the 1960's and 1970's 4000 – 5000 *A. anser* have gathered for moulting along the coast of the island of Gotland in the Baltic Sea. Between 1965 and 1975, 870 moulting geese were caught and ringed in order to elucidate their origin and migratory routes. On the basis of belly markings probably about 50 percent of the geese were one or two years old, the rest older. Some of the geese had orange-coloured bills, which has been said to be characteristic of the subspecies *Anser anser anser* with a western distribution, and some pink (light red), characteristic of the subspecies *Anser anser rubrirostris*, Swinhoe, with an eastern distribution.

The investigation has shown with many examples that some of the moulting geese originate from breeding areas south and south-west of the Baltic. From the 195 recoveries (22%) it is shown that the geese are using two different migratory routes to their winter quarters: one along the Atlantic coast towards the south of Spain, the other directly south to the Mediterranean coast of Africa. However a part of the population obviously seems to stay over the winter in the middle European countries.

The recoveries are counted up to the end of 1980 and it is shown that 60% of the recovered geese were shot or found dead in a period up to three years after they were ringed, and 95% in a period up to eight years. 89% are reported as shot, while for 11% the cause of death is unknown.

The moulting place on Gotland is considered to be very important to the non-breeding *A. anser* population from large areas of the southern part of the Baltic.

Since 1977 one of the most important feeding grounds for the moulting *A. anser* – two islands off Rone – has been protected as a Nature Reserve. In addition a tongue of land on the southwest coast – Nasudden – is protected from public trespass.

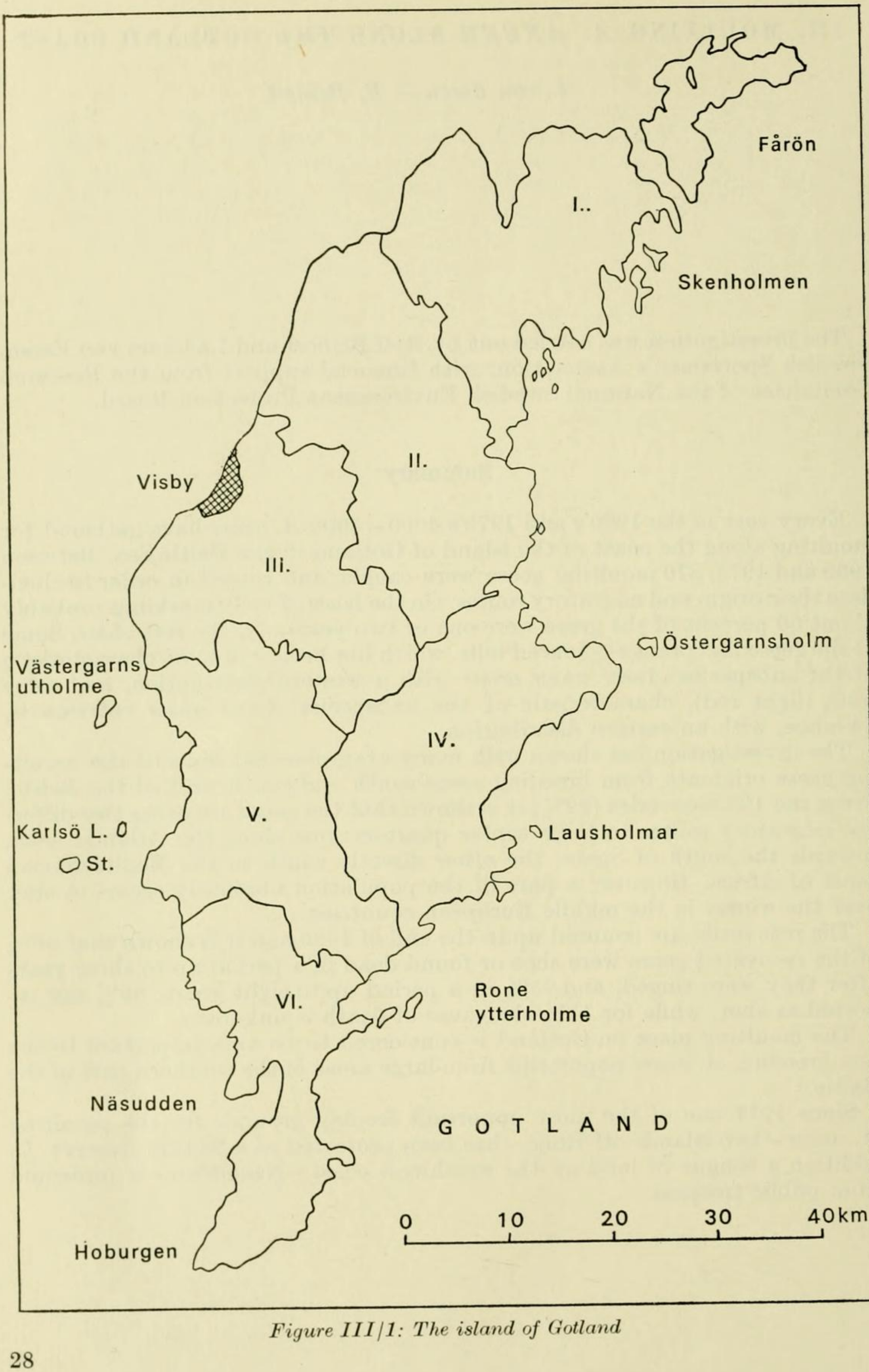

Figure III/1: The island of Gotland

The occurrence of the Greylag Goose on Gotland

For a long time Gotland has been a breeding area for the Greylag Goose (*Anser anser* L.). Even during the first half of the 20th century, when the Greylag Goose was extinct in inland southern Sweden and when there were only few geese along the Swedish east coast, there was a relatively numerous population breeding on the islets along the east coast of Gotland (*Ekman*, 1922, *Berg*, 1919). During the period 1960 – 70 the breeding population was estimated at about 100 pairs each year (*Högström*, 1971). During the period 1970 – 80 there was a marked increase, and in 1980 the population was estimated at about 300 pairs (*Beinert)*.

The southern coastal areas of Gotland have also been used as moulting areas by a considerable number of non-breeding Greylags, particularly during the last few decades. The flat, grass-covered islets and spits along the coast have been good grazing places. In addition, the geese have been relatively undisturbed there, and if they were disturbed it was possible for them to swim out into the open sea for refuge.

The largest numbers of geese have been found at Rone Ytterholme and Grötlingboholm along the south-east coast, and at Nasudden on the south-west coast. During certain years a large number of geese have also gathered at Vastergarns utholme (Figure 1).

The geese arrive in the area in late May and early June and leave gradually during July. During the latter part of June and the beginning of July the geese are unable to fly due to the moulting of wing-quills.

During the 1950's the large gatherings of geese drew more and more attention as their grazing was considered to be harmful to the grazing by cattle and sheep in those areas. Landowners claimed compensation from public funds for the deterioration of their grazing.

The number of geese that gathered for moulting in the early 1960's was estimated at 3000 – 4000. It is only in the 1970's that yearly counts from aircraft have been darried out. Due to bad weather conditions counts were

Table III/1.

Number of moulting Greylag Geese along the shore of Gotland

Plats	5/7 1973	8/6 1974	19/6 1975	24/6 1976	20/6 1977	27/6 1978	28/6 1979	27/6 1980
A) Gotland south-west (Näsudden etc.)	1530	1560	2100	2880	2230	2200	1200	1100
B) Gotland south-east (Rone ytterholme etc.)	1130	1880	1015	2250	1050	1850	2350	680
C) Gotland north-east (Skenholmen etc.)		260	155	250	200	200	50	350
Total	2660	3700	3270	5380	3480	4250	3600	2130

incomplete during the first years, but from 1973 until 1980 they have been more or less complete (Table 1). It is however probable that some small flocks of geese were not observed and included in the count. On the basis of the aircraft count the total number of moulting geese in Gotland is estimated at 4000 – 5000.

The purpose of the investigation

At the very start of the investigation it was clear that the majority of moulting geese came from areas other than the Gotland breeding area. In order to elucidate their origin, migration routes and winter quarters, geese were annually caught and ringed at their haunts along the south coast of Gotland in the period 1965 – 75. *Rolf Beinert* started the work in 1965, but from 1966 onwards the work was carried out by *Beinert* in cooperation with *Lambart von Essen.*

Capture and ringing. Notes on the birds

The latter part of June, when almost all geese had shed their wingquills, was the most suitable time for catching them. At that time the geese were gathered in large flocks.

The flocks were reached using a fast motor-boat. The geese then tried to escape by diving. In the clear water it was possible to see the birds swimming and when they came up to the surface to breathe, it was possible to catch them in a vag net. To succeed, the water surface should be quite smooth and the boat should be easily steered. The best time of the day for catching the geese was at early dawn. In order not to scare the birds away from their grazing places we avoided catching them in the vicinity of these. The total number of Greylags caught during the period was 870.

The birds were ringed with rings from the Swedish Museum of Natural History. For some birds sex, belly markings, bill colour, and weight were noted. As only a few birds were sex-determined, sex distribution has not been included in this investigation.

In order to get an idea of age-groups the occurrence of black feathers on the belly was noted for 458 of the birds caught. On captive Greylags it has been noted that yearlings and one-year old birds have light bellies without black spots, whereas older geese have varying amounts of black spots. *Fabricius* (1962) has reported that black spots occur to a greater extent in the gander than in the female. There are also some individuals with a dark greyish belly wash. Consequently, birds without black spots have been presumed to be one year old, and those with black spots or dark greyish bellies to be two years old or more. These were divided into three groups (Table 2). Group 1 probably contains mainly two-year old birds, groups 2 and 3 birds more than two years old.

According to various sources the western subspecies of the Greylag goose (*Anser anser anser* L.) has an orange-coloured bill, whereas the bill of the eastern race (*Anser anser rubrirostris*, Swinhoe) is light red (pink). The colour of the bill was noted for 381 of the birds. It was shown that in the area there

Table III/2.

Belly markings and bill colour of a number of Greylags examined in the hand

	Belly markings						Colour of the bill			
Year	pull 0	0	1	2	3	S:a	G	M	R	Total
1969	5	15	12	14	14	60				
1970		35	25	18	31	109	59	15	22	96
1971		15	11	13	18	57	15	25	17	57
1972		20	10	13	15	58	20	14	23	57
1973	2	18	21	26	26	93	47	9	34	90
1974		15	15	10	16	56	23	23	10	56
1975		7	6	3	9	25	13	9	3	25
Total	7	125	100	97	129	458	177	95	109	381
%	1.5	27.3	21.8	21.2	28.2	100%	46.5	24.9	28.6	100%

Belly markings: 0 = No black markings
1 = A few black spots (max. 10)
2 = A moderate number of black spots or greyish wash
3 = Richly black-spotted

Colour of the bill: G = Bill orange
M = Intermediate
R = Bill pink

Geese in columns 0 and 1 are presumed to be up to two years old, those in 2 and 3 are presumed to be older.

were both geese with yellowish bills and with clearly light red (pink) bills. The distribution is shown on Table 2.

On 18 – 20 June 1968 100 of the geese were weighed. The following result were obtained:

The average weight of 11 geese without black spots on the belly (probably one year old)	3.04 kg
The average weight of 89 geese with black spots on the belly (probably more than one year old)	3.29 kg
The average weight of the 100 geese	3.27 kg

Recoveries of ringed geese

Until 31 December 1980, 195 of the 870 ringed geese (22%) had been shot or found dead (Table 3). The geographical distribution of recoveries is shown in Figure 2. The distribution between countries and months is shown in Table 4. Two geese reported from Mecklenburg and one from Zealand (Denmark) which were identified living, have been included in the table. The ones from Mecklenburg were ringed in Gotland on 26 June 1973 and controlled at Göstrow on 8 April 1976 and 17 May 1976, respectively. The first-mentioned goose was then breeding.

It is evident from the map (Figure 2) that the Greylag Geese moulting in Gotland use two different migration routes, one along the Atlantic coast to the south of Spain, and the other across eastern Germany, Poland to Czechoslovakia and Austria. It also appears that flocks of geese from this

Table III/3.

Numbers of ringed Greylags, recoveries and the duration of life after the year of ringing

Ringed		Recoveries number, %		Recoveries up to 30 June after the following number of year												
year	number			0	1	2	3	4	5	6	7	8	9	10	11	12
1965	28	10	36	4	1	1	3		1							
1966	48	7	15	2	1	1	1		1				1			
1967	147	40	27	10	11	5	4	4	2	1	1	1				1
1968	182	42	23	7	11	11	5	1	1		2	1	2	1		
1969	60	17	28	2	4	2		2	5	1	1					
1970	110	27	25	8	4	2	2	3	3	1	3	1				
1971	57	11	19	4	1			2	1	1		2				
1972	58	10	17	2	2	1		1	1	1	2					
1973	93	12	13	4	2		1		3	1	1					
1974	62	12	19	3	2	3	1	1	1	1						
1975	25	7	28	5			1	1								
Total	870	195	22%	51	39	26	18	15	19	7	10	5	3	1		1
%		100%		26.2	20.0	13.3	9.2	7.7	9.7	3.6	5.1	2.6	1.5	0.5		0.5

contingent continue their flight across Italy to the Mediterranean coast of Africa.

The length of life and the year of ringing have been compiled in Table 3. It shows that about 60% of the recovered birds died within three years of ringing and about 95% died within eight years of ringing.

Recaptures in Gotland of Greylag Geese ringed in other countries

Some of the geese caught had been ringed in other countries, and as this is particularly interesting all the cases are reported here.

1. Controlled on 1 July 1968, ringed as a gosling on 13 June 1967 near Copenhagen.
2. Controlled on 1 July 1968, ringed as a gosling on 21 June 1967 near Copenhagen.
3. Controlled on 20 June 1968, ringed when moulting on 28 June 1962 at Vejlerne, Jutland, Denmark. The goose was shot on 7 October 1971 in Mecklenburg, East Germany.
4. Controlled on 27 June 1969, ringed as a gosling on 24 June 1958 in Funen, Denmark. The goose was shot on the river Guadalquivir, Spain on 8 October 1974 at the age of 16 years.
5. Controlled on 25 June 1974, ringed as a gosling on 10 June 1973 on Rügen.
6. Controlled 2 July 1974, ringed as a gosling on 10 June 1973 on Rügen.

The following geese ringed abroad were shot on Gotland at the end of July or beginning of August:

Table III/4.

Distribution of the recoveries – country and month

Country	Month	7	8	9	10	11	12	1	2	3	4	5	6	Date un-known	Total
Sweden		7	18	3								1	2	1	32
Denmark			22	8	6	1				1				2	40
German Demo-cratic Republic		11	11	5	1				2	1	1	1		1	34
Germany, Federal Republic of			2	3	6										11
Holland					1	2	3							4	10
Belgium															0
France					2	2			4						8
Spain				1	3	11	6	4	3	1				6	35
Poland				1					1	4	2				8
Czechoslovakia			1		3	1		1							6
Austria					4		1		2					1	8
Yugoslavia								1							1
Italy						2									2
Algeria							1	1							2
Tunisia								1							1
Total		18	54	21	26	19	11	8	12	7	3	2	2	15	198

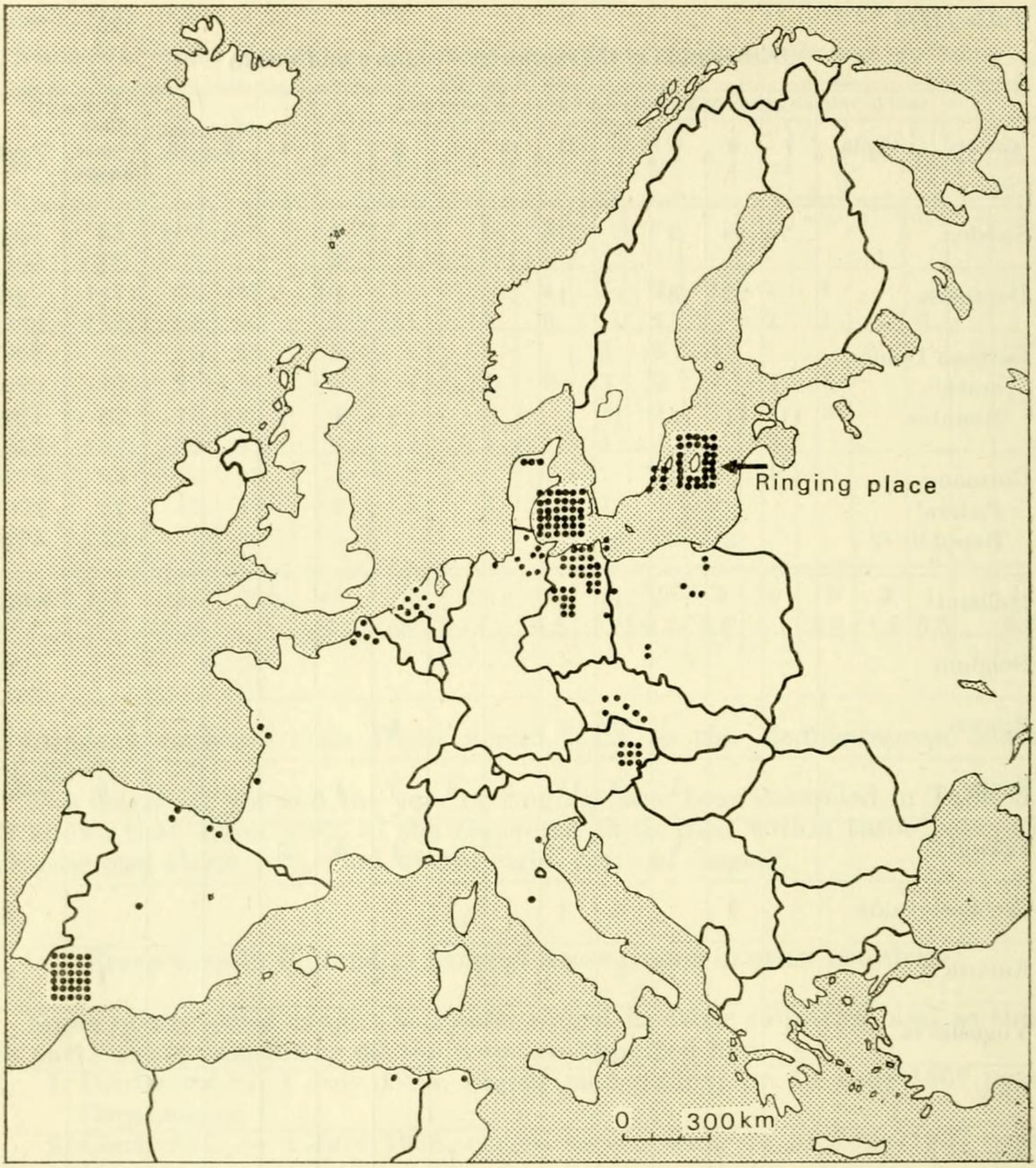

Figure III/2: Recoveries of 198 Greylag Geese ringed at Gotland 1965 – 1975

7. Shot in August 1968 at Klintehamn, Gotland, ringed when moulting at Vejlerne, Jutland, Denmark on 28 June 1962.
8. Shot on 1 August 1973 at Nas, Gotland, ringed as a gosling at Seewiesen, Bavaria in 1965.
9. Shot on 20 July 1979 at Hablingbo, Gotland, ringed on Zealand on 23 June 1978.
10. Shot on 23 July 1979 at Nasudd, Gotland, ringed at Neser-Ems, West Germany, on 18 June 1972.

Thus, recapture No. 8 shows that a goose born at the research station of Seewiesen, Bavaria in 1965 was present on Gotland eight years later.

We can also mention here that a goose caught and ringed at Gotland on 25 June 1974 and shot in Mecklenburg on 17 July 1976 was described as "a pair with goslings". It is probable that this pair was breeding there, as it was in the middle of July.

This means that there is much evidence that many of the greylag geese that moult at Gotland were born, or have been breeding, further south, e. g. in Denmark, Mecklenburg (GDR) or Bavaria (FRG).

Stig Carlström (Blekinge) has reported that flocks of 15 – 20 greylags can be seen at Torhamn (south-east Blekinge) around 20 May every year, flying in north-easterly direction. It is supposed (and is probable) that the flocks are on their way to Gotland.

The importance of Gotland as a moulting place for Greylag Geese

During the last two decades the breeding population of greylag has shown a marked increase along the whole of the Swedish east coast. This increase has been particularly marked in the archipelago of Lulea, the Hudiksvall area, the archipelago of Stockholm, Kalmarsund and the archipelago of Bleckinge. In addition new breeding areas have been established along several stretches of coast (*Nilsson,* 1981 and others).

In several lake areas in the south of Sweden the Greylag Goose has started breeding again and has become more numerous. Until now some areas in Skane, southern Småland, Västergötland, Lake Takern in Östergötland and parts of Södermanland have been colonized.

Leif Nilsson estimated the total population of breeding Greylag Geese in Sweden during the years 1979 – 1980, at 1600 – 2100 pairs (1981).

In some localities along the coast, geese have gathered in growing numbers in late summer. The grown broods have successively gathered in large flocks at the end of July and in August. In 1980 there were about 1000 geese at each locality. Some such localities are Lövsta Bay in northern Uppland, Tullgarn in Södermanland, Braviken in Östergötland and Warnanas in Kalmarsund (the straits between the mainland of Sweden and the island of Öland). A feature common to these localities is the presence of large cornfields, where the geese can feed on ripening corn. There are also relatively calm water areas (bays) for resting during the day and night there.

In spite of the general increase in the number of Greylag Geese only two new small gathering places of geese during moulting time have been reported. One locality is Lillfjärden in Hudiksvall, where about 200 greylags have gathered for moulting together with an approximately equal number of Canada geese during the last few years. The other locality is Lake Takern, where according to K. Strand, a growing number of non-breeding geese have stayed the summer during the last few years. These geese leave Lake Takern soon after they are able to fly again, that is at the end of July.

Thus is seems that the Greylags have established new moulting places only at these two localities. This means that in our country there is no other moulting place of the same size as that in Gotland, nor is there any account of such a place in the rest of the Baltic countries. Earlier there was a moulting place in Denmark, at Vejlerne in the north of Jutland, which received large numbers of geese, even geese coming from south-eastern countries (*Paludan*, 1965). During the 1960's the number of geese at that locality declined drastically, so now that locality and two more localities are moulting places for mainly local Greylag Geese populations in Denmark.

No major moulting place has been reported from Finland. E. Kumari writes in a letter from Estonia in 1978 that number of greylags is steadily increasing, although they are not gathering at a mouting place. No reports of the establishment of any major moulting place have been made in Poland or in East Germany.

The three Swedish moulting places at Gotland (principally Rone Ytterholme), Hudiksvall (Lillfjärden) and Lake Takern have one feature in common: nutritious grass growing in the immediate vicinity of an open beach. At the Rone and Takern localities there are grass meadows grazed by cattle and at Lillfjärden there are mown lawns. It seems to be an imperative requirement that the beach should be open, as the geese are easy victims of predators, mainly foxes, during this period, and they are also disturbed by human activies. For this reason they need to have a clear view, so that they have time to swim out into the lake or sea. At Lillfjärden in the centre of Hudiksvall the geese have adapted to the "harmless" people on the lawns, and there are no boats that disturb them on the water.

As has been proved by ringing, Gotland is an important place for Greylag Geese from southern countries. The fact that non-breeding geese find a suitable moulting place in the north applies to other goose species as well, such as the Canada Goose in North America and the Bean Goose in Russian and Asia (*Owen*, 1980). Gotland and the islets around it can evidently offer the ecological environment that Central European greylags need for a moulting place. Such localities are probably scarce.

During the last two seasons of moulting, Greylag Geese in Gotland have decreased: in 1980. 2. 125 were counted and in 1981. 1. 800. The decrease in 1981 may partly be due to the disastrous starvation that occurred in the wintering area in Spain. However, it seems urgent from the international point of view also, that as far as possible the geese on Gotland are left in peace at those localities most frequented during moulting in June and early July.

Since 1977 one of the most important feeding grounds for the moulting greylags – two islands at Rone – is protected as a Nature Reserve. In addition tongue of land at the south-west coast, Nasudden, is protected from public trespass.

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IV. STABILITY AND DYNAMICS IN THE SOCIAL STRUCTURE OF THE GREYLAG GOOSE *(ANSER ANSER)*

E. Rutschke

Introduction

For decades the biology and behaviour of the Greylag Goose has been the object of scientific investigation. An early but important study on their breeding biology was published by *Christoleit* (1929). *Lorenz* and *Tinbergen* (1938) who in studying the egg-rolling-movement came to a theoretically important conclusions on the combining of genetically fixed and learned behaviour. The detection of the phenomen of imprinting took place by *Lorenz* on goslings of the Greylag Goose and *Lorenz*, Greylag-gosling "Martina" has become a world-famous animal. Further progress in the study of behaviour and biology has been obtained by *Fischer* (1965) and *Young* (1972).

On the other hand the population ecology and social behaviour of this species has not been so intensively investigated. The moult migration was studied at first by *Paludan* (1965) and later more precisely characterized in Central Europe by *Haack* and *Ringleben* (1972). The different types of social groups in this species are well-known and well described, however, there are many open questions on the mechanism of forming social groups and their function.

For instance, very little investigation has taken place on the forming mechanism of cohesion in non-breeder flocks. The biological importance of flocking behaviour on the White-fronted Goose *(Anser albifrons)* has as yet not been studied as well as by *Lazarus* (1978) or what has been done by *Drent* and *Swierstra* (1977) and *Drent* (1980) on the Barnacle *(Branta leucopsis)* and Brent Goose *(Branta bernicla)*.

Furthermore, most of the knowledge about the biology and behaviour of the Greylag Goose has been obtained investigating captured animals. Only a few scientists have gone by the hard way of field observations.

For this reason we have strated field investigations on population ecology and social ethology in this species. At present this time-consuming work has not been completed. Therefore, the aim of this paper is to give a review of the first results and not the final picture.

The study areas

1. Nature reserve Lake Gülpe

The main important study area is Lake Gülpe, situated in the district of Potsdam on the river Havel. The breeding stock is between 40 – 80 pairs depending on the course of spring flooding. Furthermore, the area is a gathering-ground for non-breeders in spring (maximum number in the 3. May-

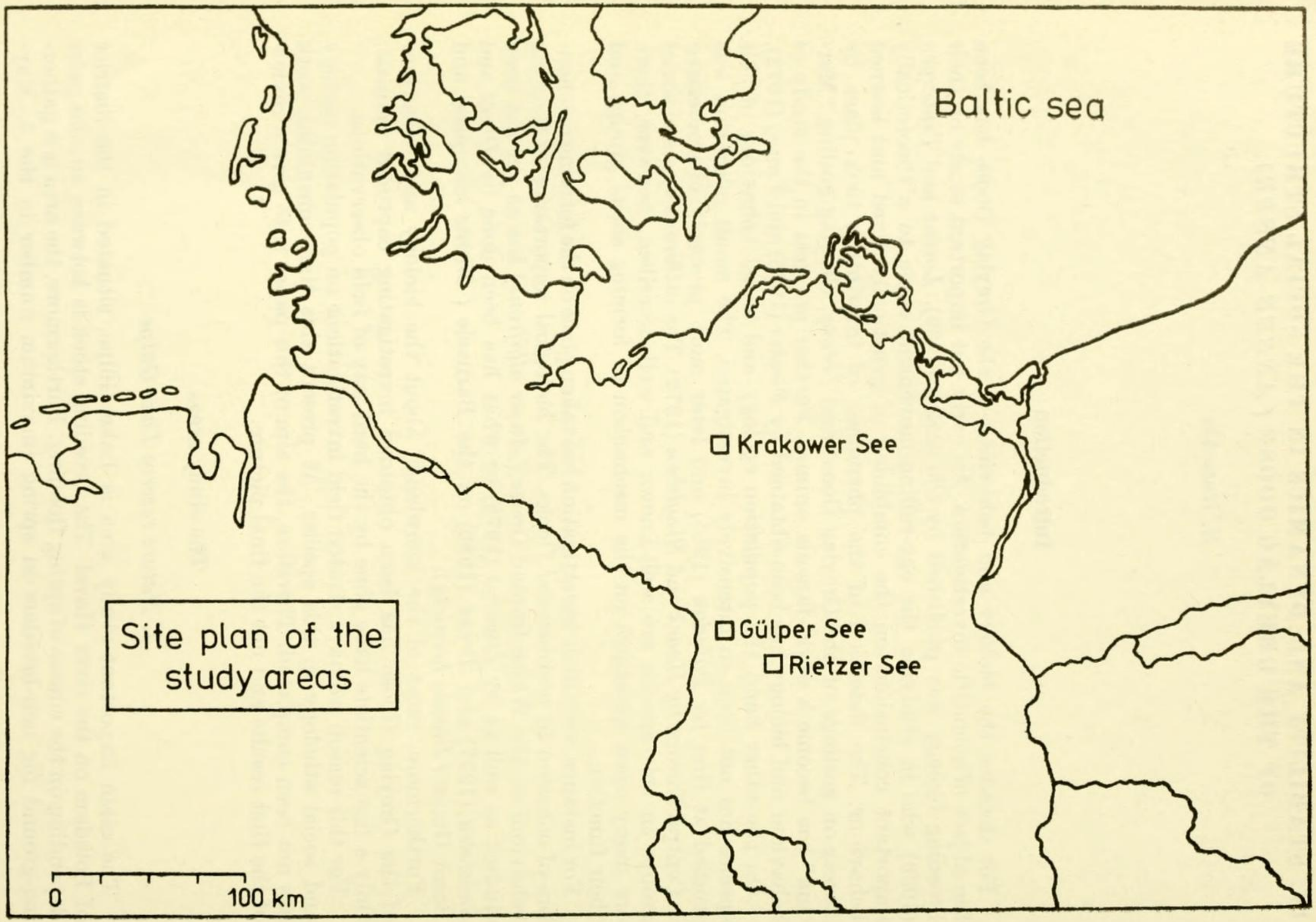

Figure IV/1: Site plan of the study areas decade is 800) and summer gathering-ground. The gathering of geese in summer begins in mid-July (maximum number at the end of July 1981 approximately 3500) continuing until the end of August. At the beginning of September the stock is raised to 6000. The off-migration begins in October.

2. Nature reserve Lake Rietz

This lake is situated 50 km west of Potsdam. It is important only as a breeding area with a breeding population of up to 30 pairs.

3. Nature reserve Lake Krakow

The nature reserve Lake Krakow is situated in the western part of Mecklenburg inside the "Mecklenburgische Seenplatte". The breeding population of this area runs up to 40 pairs. Furthermore, this study area is a gathering and resting ground for non-breeders (800). Fig. 1. shows the position of the three study areas.

Additional knowledge about social behaviour has been obtained during excursions to other breeding, gathering and resting grounds of the Greylag Goose in the GDR.

Methods

The main method of studying problems of socio-ethology was individual marking by coloured neck-collars after capturing by cannonnet-equipment. Neckbanding of the Greylag Geese at Lake Gülpe has taken place since 1973. At first neck-collars with pennants were used. Since 1975 neck-collars with engraved letters and numbers have been applied. During the first years a two-digit-code was in use. Based on an agreement obtained at Slimbridge in 1979 a three-digit-code is now used.

At Lake Gülpe were ringed families (in June), non-breeders (in May) and summer birds (August/September).

At Lake Rietz only families were caught and ringed.

At Lake Krakow only non-breeders (May) and summer birds (August) were ringed.

A summary of the number of all Greylag Geese caught and ringed since 1975 is given in Table 1.

Table IV/1.

Numbers of ringed Greylag Geese in the study areas 1975 – 1981

	1975	1976	1977	1978	1979	1980	1981	Total
Lake Gülpe	63	21	44	66	17	8	143	362
Lake Rietz	33	–	19	9	–	–	–	61
Lake Krakow	102	32	4	–	–	–	–	138
	198	53	67	75	17	8	143	561

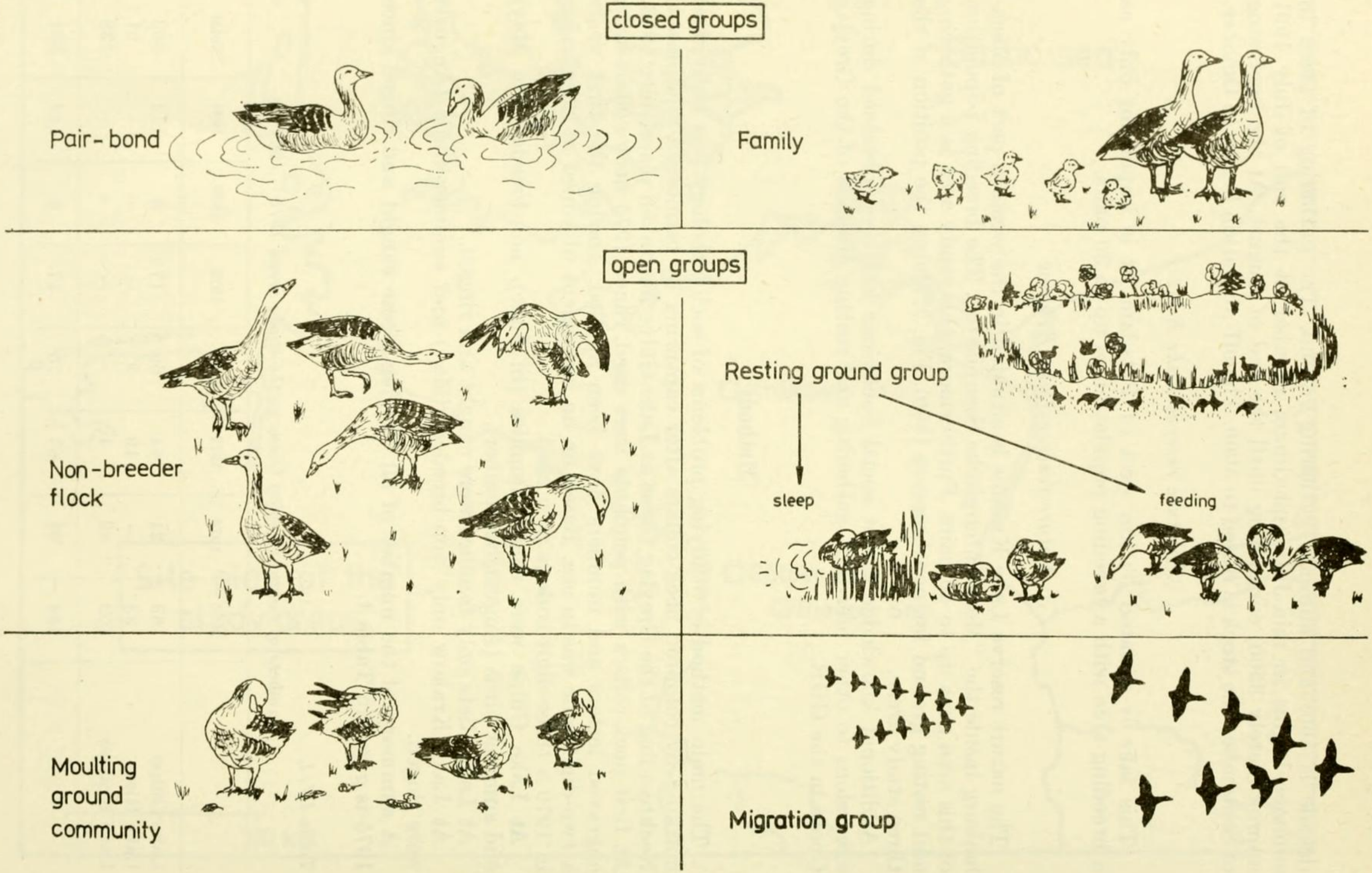

Figure IV/2: The various social groups of the Greylag Goose

I am very grateful to *dr. Litzbarski* and *dr. Warthold* for their helpful work and to a very large number of ornithologists for their assistance as members of the netting team and giving other technical assistance.

Types of socializing in the Greylag Goose

Only for a short phase of their lives are Greylag Geese without adhesion to other birds, namely, immediately after hatching. A few hours later the first social contact is realized by imprinting. Normally, no phase of isolation follows during the life span and at most, only for a short time, as for instance, after the death of a member of a pair.

There are two different types of social structures in the Greylag Goose, namely, closed and open groups (Fig. 2). The first type is characterized by a defined and limited number of members knowing themselves and not interchangeable. These are the pair and the family. The second type is characterized by anonymity and a variable and changeable number of members. These are the non-breeder, moulting, resting, and gathering ground groups including groups with special biological functions (feeding, sleeping and migrating). Generally, the different structures are described by *Hudec* and *Rooth* (1970) (Fig. 3).

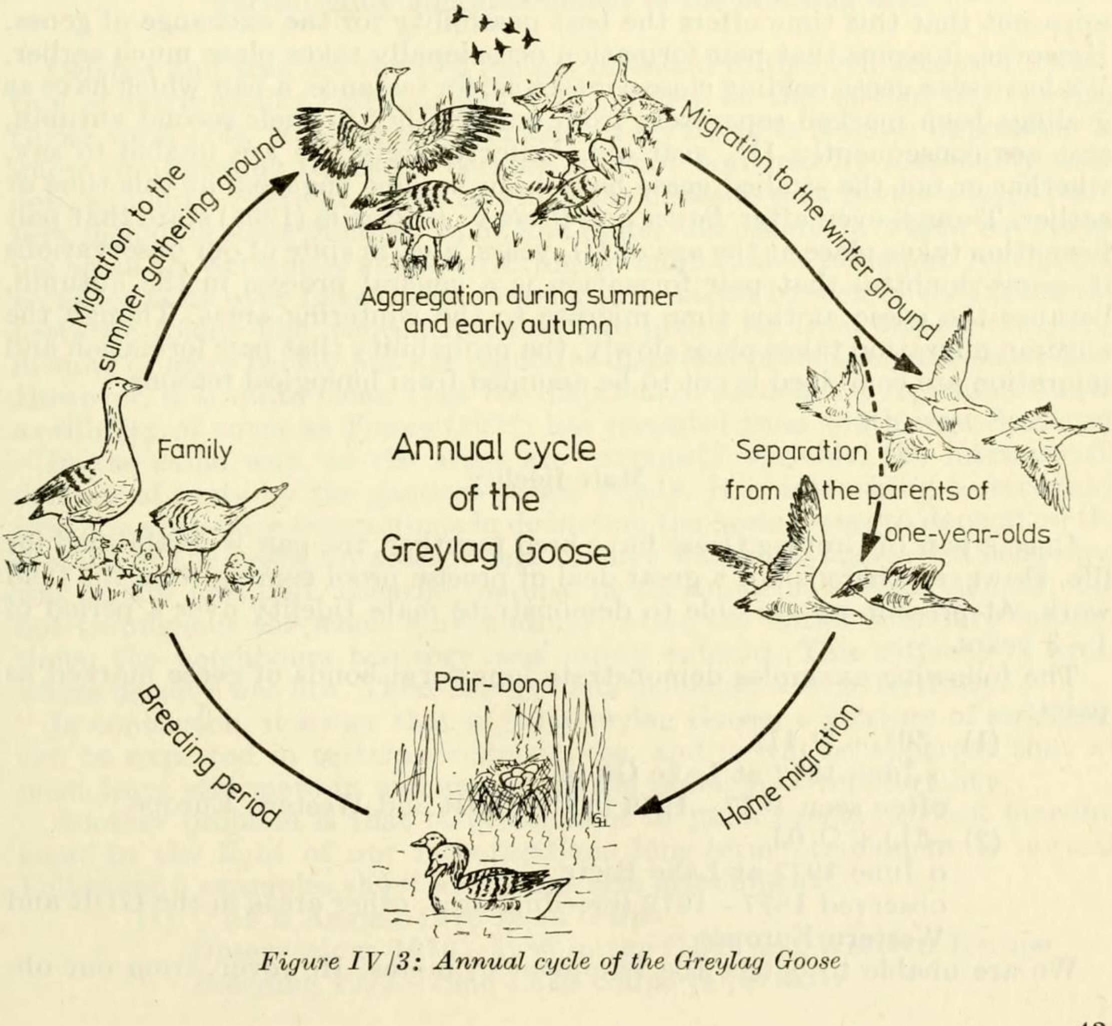

Figure IV/3: Annual cycle of the Greylag Goose

Mechanism of forming, stabilization and disengagement of the various social groups

The pair

Throughout the whole kingdom there are very few monogam species, but the Greylag Goose is one of them. There is extensive literature concerning the problem of pair forming in Greylag Geese, but, unfortunately, the observations are obtained in the first place from captured animals. Most authors follow *Lorenz*, who asserts that pair formation is a consequence of sexual imprinting.

There is no doubt, that pair formation takes place in the second year. However, from the point of view of population genetics, it is necessary to have more precise and detailed knowledge about the time of pair formation, and where it takes place, because, the possibilities for the exchange of genes depend on the number of possible partners in the population.

There are many indications that pair formation takes place during winter at the end of the first year. During this time practically the whole population coming from central and north-east Europe is concentrated in a relatively small area (the Marasmas of the Guadalquivir in Spain). From the above it is apparent that this time offers the best possibility for the exchange of genes. However, it seems that pair formation occasionally takes place much earlier. We have seen geese holding close contact as, for instance, a pair which have as goslings been marked separately from one another in their second autumn, and are consequently $1^1/_2$ year old. Unfortunately, we are unable to say, whether or not the studied geese have been become engaged, at this time or earlier. Though even after *Bauer* and *Glutz* v. *Blotzheim* (1968) state that pair formation takes place at the age of $1^1/_2$ years, and, in spite of our observations it seems doubtful that pair formation is a general process in the autumn, because the geese at this time migrate to the wintering areas. Though the autumn migration takes place slowly, the probability that pair formation and migration are combined is not to be assumed from biological reasons.

Mate fidelity

Once a pair of Greylag Geese have bred together, the pair is established for life. However, there is not a great deal of precise proof coming from the field work. At present we are able to demonstrate mate fidelity over a period of 1 – 3 years.

The following examples demonstrate long-term bonds of geese marked as pairs:

(1) ♂0L + ♀ 1L
o June 1977 at Lake Gülpe
often seen 1977 – 1979 in the GDR and Western Europe

(2) ♂1J + ♀ 0J
o June 1977 at Lake Rietz
observed 1977 – 1979 (breeding area, other areas in the GDR and Western Europe)

We are unable to detect the take-over of mates. However, from our observations this question cannot be regarded as definitivy solved, because the number of marked pairs and well-documented courses of life are much too narrow. Formerly, it was assumed that new-pairing by the loss of a mate didn't take place. We know of some cases where one member of a pair has newly-paired after the loss of its mate.

Age of mating (or sexual maturity)

In literature there are contradictory opinions as to the age of mating. According to *Delacour* (1954) the first breeding takes place in the third calendar year (22 months old). According to *Bauer* and *Glutz* v. *Blotzheim* (1968) breeding is most frequently succesful in the fourth year. Our investigations don't allow a definite answer, but, in some cases we have found succesful breeding before the 2nd year was complete (third calendar year) (Fig. 4). However, it should be noted, that a young male was paired with an old female of undefined age.

Territoriality and attachment to the breeding area

Defence and area are the two factors intended in the well accepted definition of territoriality (*Mineau* and *Cooke*, 1980). In the case of the Greylag Goose from both factors arise problems. Very often it is quite impossible to know the breeding territory, because it is not bordered by reasonably well-defined limits. There are cases in which the nest site area covers a large territory including some hundred sq.m. and more, and others, in which the breeding areas are extremely small, covering no more than a few sq.m. As the dispersal of nests over Lake Gülpe shows Fig. 5. As can be seen in the figure, the nests are colony-like, concentrated on two places far from one another, and in spite of more widely but not regularly dispersed nests along the shore-line. However, it is quite clear, that the dispersal of nests is not regulated by the availbility of cover as *Young* (1972) has recorded from south-west Scotland.

In the same way, as the areas are extremely variable, the intraspecific defence of nests by the ganders varies widely. It is interesting to recognize that the aggressive interactions in defending the nests seems to depend on the density of the nests. In areas where density was high, aggressive behaviour was highly localized, occuring mainly in the immediate nest vicinity, but not throughout the whole surroundings. After the initial boundary interactions, the neighbours territory was rarely entered. This differed in areas where density was low. There the ganders defended a large territory.

In conclusion, it seems that in the Greylag Goose, a mixture of strategies can be expected in certain circumstances, and it will be apparent that we must learn still more in understanding the problem of territoriality.

Another problem is that of attachment of pairs to the choosen breeding area. In the light of our investigations long-term attachment is normal. Following 3 examples show such long-term attachments.

(1) ♀ 6F o August 1976 Lake Gülpe
Observations 1976 – 1980 in the GDR and Western Europe
Breeding 1977 – 1980 Lake Gülpe (4 periods)

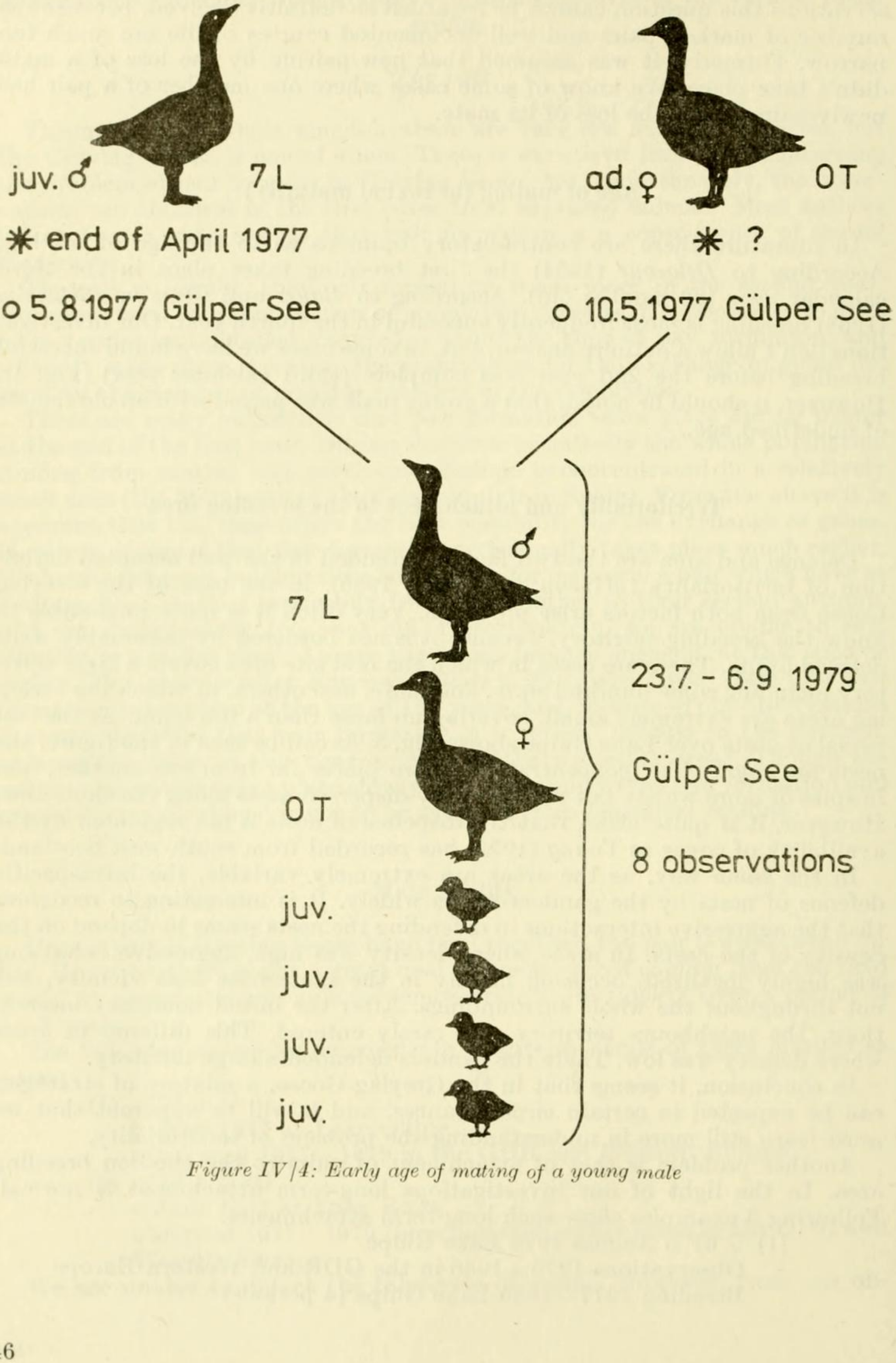

Figure IV/4: Early age of mating of a young male

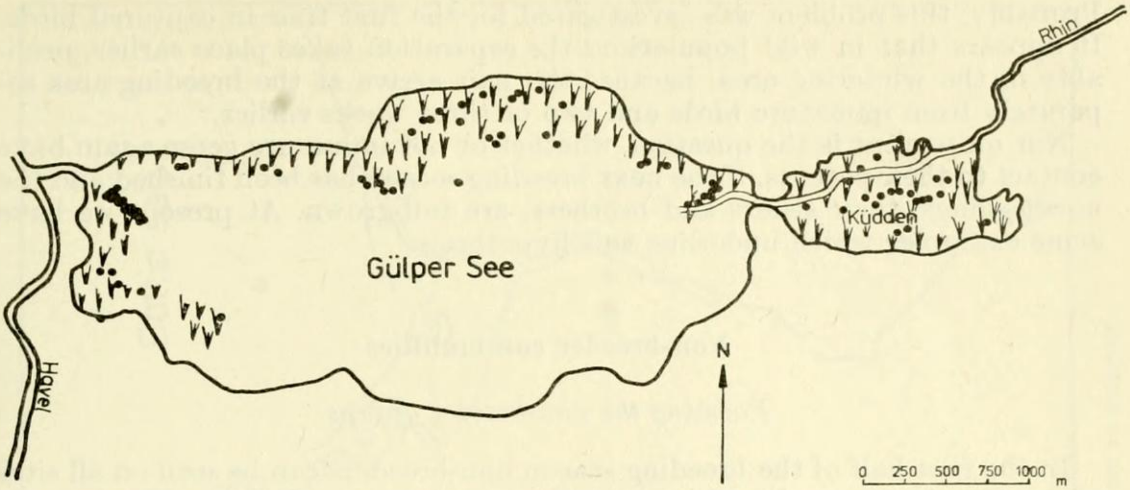

Figure IV/5: Distribution of nests of the Greylag Goose over Lake Gülpe

(2) ♀ 8A o May 1976 Lake Krakow
Observations 1976 – 1980 in the GDR and Western Europe
Breeding 1976 – 1980 Lake Krakow (5 periods)
(3) ♀ CO1 o May 1975 Lake Gülpe
Observations 1975 – 1979 in the GDR
Breeding 1976 – 1979 Lake Gülpe (4 periods)

The family

The term "family" includes the pair and their youngs. Therefore, the term is not quite identical with the use in man. The pair and the under one-year-olds keep together until the new nesting season comes. From observations in captured Greylag Geese, there are many indications that between the goslings exist a rank order. The development of rank order in groups of sisters and brothers has been investigated by *Kalas* (1977). The goslings are bonded to their parents by imprinting. Unfortunately, it is very difficult under natural conditions to prove both rank order and imprinting. However, it will be noted that cases of adoption of foreign goslings by Greylag Geese are not rare. In geese breed in high density, up to 35 goslings join in one "family" (*Prill* 1980). This leads to the question, whether in conditions of high breeding density, the Greylag Geese form a nursery creche as is known from sea-ducks. However, the development of large groups of goslings is not well understandable by filial imprinting, therefore, it should be furthermore proved. As on the example of Mallard filial imprinting, *Sjölander* (1980) has critizised the concept of imprinting from a methodical point of view.

Separation of the young birds from their parents

The separation of parents and young which takes place is influenced and controlled by sexual hormones at the beginning of the new mating period. The separation takes place by the active driving off of the young by the parents in the breeding area (Lit. see *Bauer* and *Glutz* v. *Blotzheim*, 1968).

Probably, this problem was investigated for the first time in captured birds. It appears that in wild populations the separation takes place earlier, probably in the wintering area, because the pair arrive at the breeding area separately from immature birds and two or three weeks earlier.

Not quite clear is the question, whether or not immature geese again have contact to their parents, if the next breeding season has been finished and the new goslings, their sisters and brothers, are full-grown. At present we have some examples which underline this hypothesis.

Non-breeder communities

Forming the non-breeder groups

In the first half of the breeding season non-breeders can be seen on all sites where Greylag Geese breed in more than 5 – 10 pairs. The non-breeders are live separately from the pairs, organized in relatively stable flocks. The size of the flocks depend on the size of the breeding stock. The larger the breeding stock the larger the non-breeder flock. From mid-March to the end of April the non-breeders move from most breeding sites. They all gather at a few sites called main resting or gathering sites for non-breeders. On these sites the non-breeders stay from the end of April until the end of May.

Summarizing, the process of forming non-breeder flocks takes place in two steps: (1) the non-breeders of one breeding site form the local non-breeder flock, (2) all non-breeder flocks existing in a large area, gather on one non-breeder gathering ground.

In the GDR are located up to 10 main non-breeder resting grounds. They are also in all cases, important breeding areas in which usually more than 30 Greylag pairs breed. The non-breeders live absolutely separate from the pairs. The rhythm of daily activity can be described as follows. In the morning they fly in one group to the feedings grounds. After returning to the lake, they rest for the greater part of the day at defined places, cleaning and preening the plumage. In the late afternoon they once again fly to the feeding grounds.

During the summer the non-breeders don't stay all the time at one place. We have found within a short time a quick change of resting grounds (Fig. 6).

In summer and autumn failed breeders also have the tendency to change the resting ground. This is demonstrated by the following example:

♂ ad. 4U
o Mai 1978 Lake Gülpe
Summer- and autumn observations 1980:
August – Müritz sea area
September – Iceland of Poel
October – Lake Gülpe

At present we do not have knowledge about the size of the area from which the non-breeders come to the main gathering grounds. We hope to obtain more information by individual markings at numerous breeding sites, though it is difficult for methodical reasons. However, during the following year it is possible to draw conclusions from marking experiences at main resting grounds, if the non-breeders fly back to their home range. At present we have many observations of non-breeders marked in April at the main non-

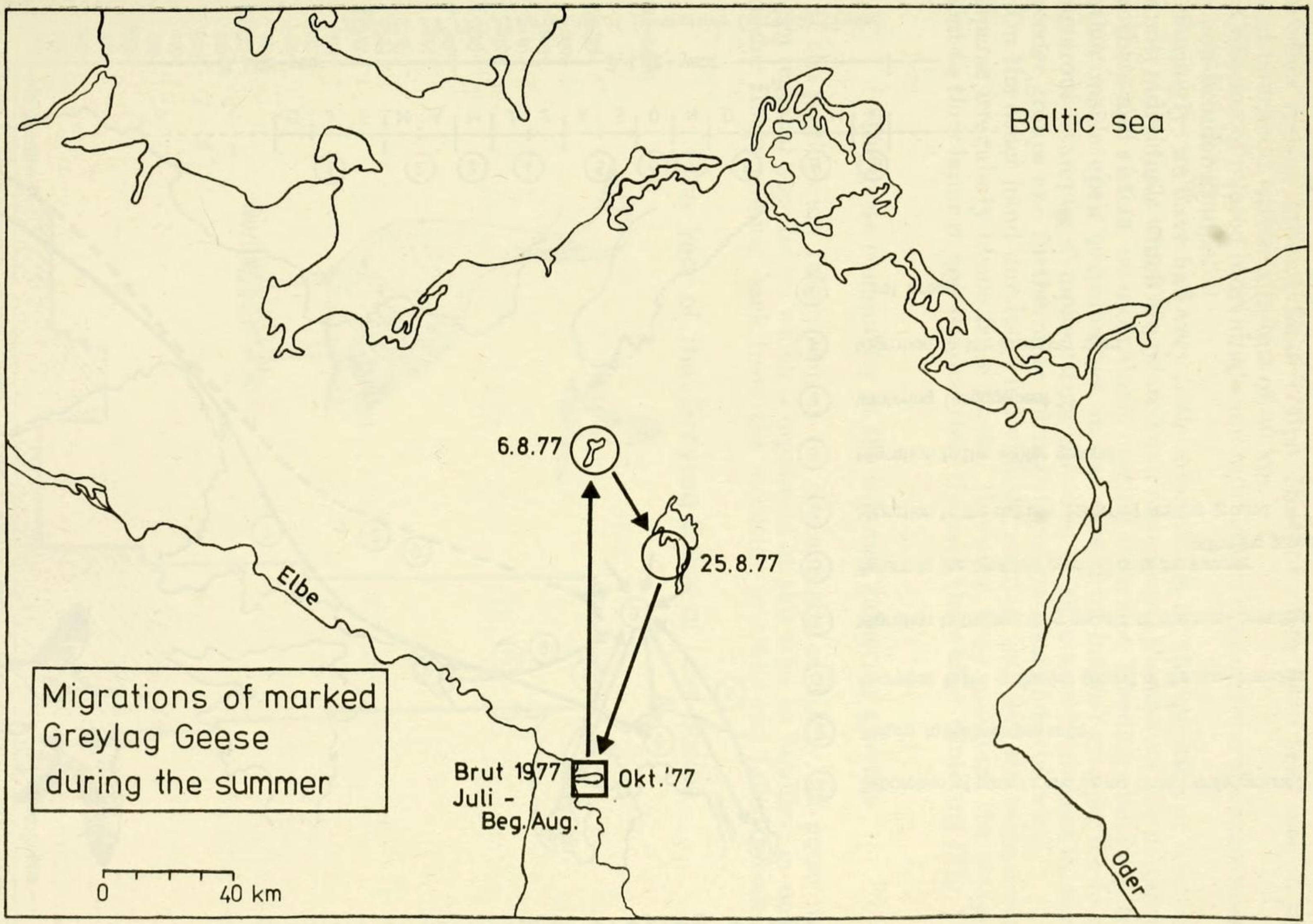

Figure IV/6: Migrations of marked immature Greylag Geese in summer

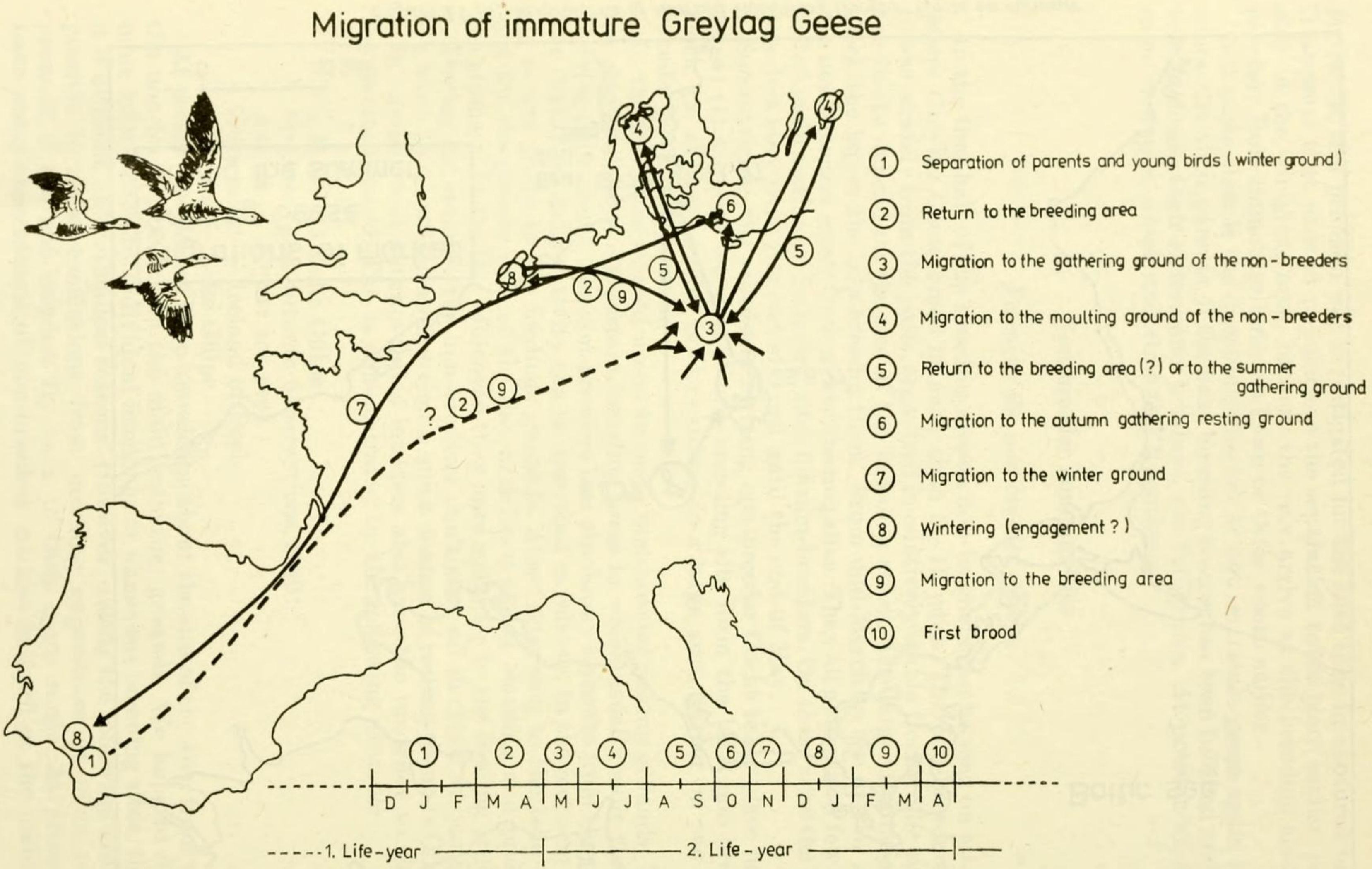

Figure IV/7: Migration of immature Greylag Goose breeders resting ground Lake Gülpe. Most of them have been seen in the neighbourhood within a radius of 80 km.

Cohesion of related individuals and individuals coming from the same areas in non-breeder groups.

Formerly, we have had very little information on the question of whether or not, individuals which are related and recognizing themselves, for instance, brothers and sisters, or individuals coming from one breeding site, keep together inside open communities, in our case in on-breeder groups. We have numerous examples demonstrating cohesion of sisters and brothers in non-breeder groups and furthermore during the migrations and wintering.

On the other hand unrelated individuals, coming yet from the same areas, disperse irregularly inside large flocks. However, they maintain the attachment to their home range, because they fly back there after wintering (Fig. 7).

The geese community at the summer gathering grounds

If the goslings are full-grown, at the beginning of mid-July, all geese of a given regional population which is organized at this time in families, in non-breeder flocks coming back from the moulting grounds and failed breeders

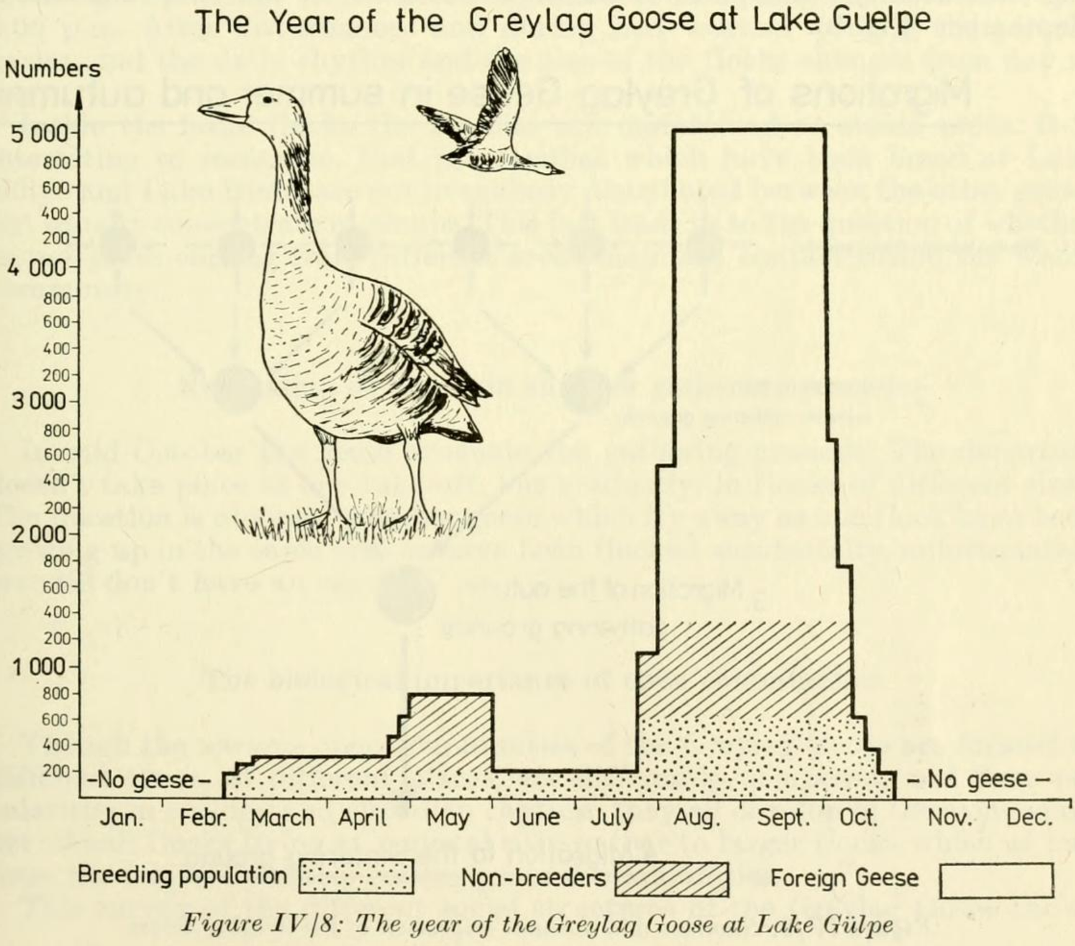

Figure IV/8: The year of the Greylag Goose at Lake Gülpe begin to collect on a few sites. These sites we call summer gathering or resting grounds. These sites are used by geese from the end of July to mid-October, until the migration to the wintering grounds begin.

In the GDR in summer the geese gather at a few sites only. The most important inland gathering ground is Lake Gülpe. From 1979 to 1981 5000–6000 geese have been concentrated there in summer and early autumn: the largest inland concentration in Central-Europe (Fig. 8). The other large summer gathering site is situated at the Baltic Sea coast between Rügen and Hiddensee. Here the maximum number in summer is 10 000. In autumn the stock increases to 35 000.

The development of summer gathering ground communities

The gathering of the geese after the nesting period probably develops in the same manner as the gathering of non-breeders before departure to moult migration. In the first place the families from one breeding site and the neighbouring smaller breeding sites gather at one suitable place. Duration at these local sites and the size of the flocks are very different depending on food supply, weather and tradition. It is interesting to recognize that normally no more than 200 to 400 geese gather at local sites. The flight to the main gathering sites usually takes place at the end of August, at the latest the end of September (Fig. 9).

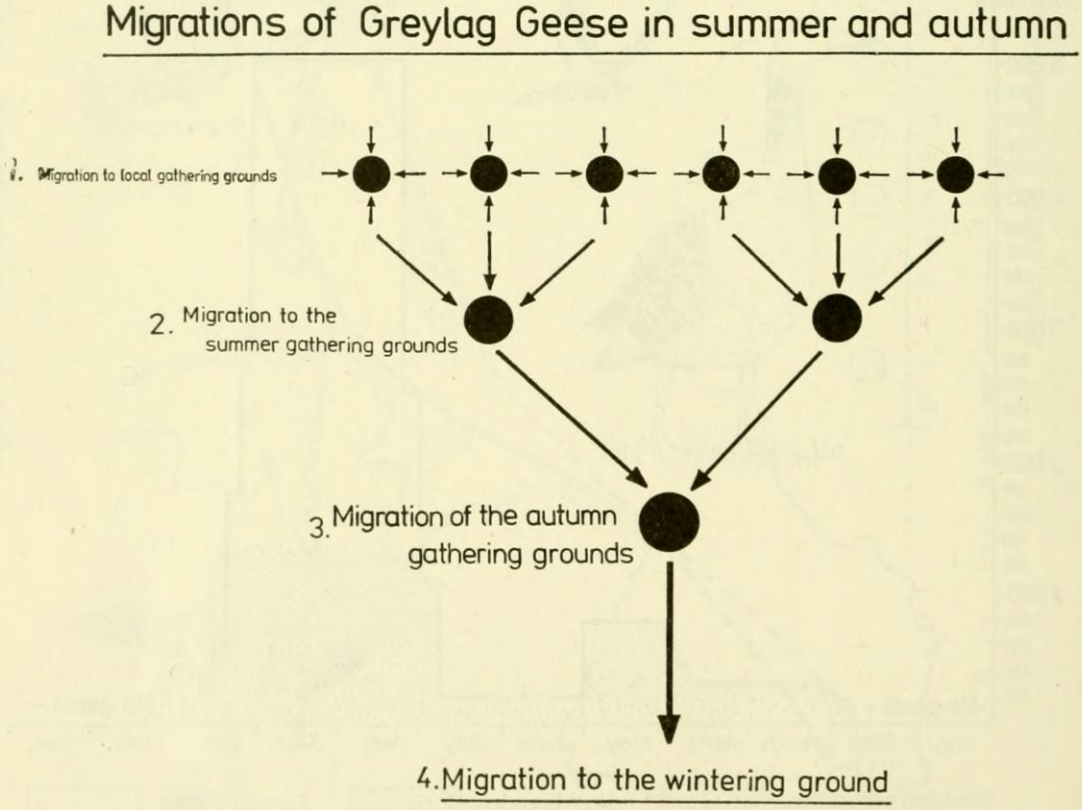

Figure IV/9: Summer and autumn migration of the Greylag Goose

However, the process of gathering is not clear in all its details. The important question is whether or not the geese fly every year to the same gathering ground, the size of the area surrounding the main summer gathering grounds, and, the stability of attachment to the choosen site.

By our investigations the migration of geese breeding at Lake Rietz to the main gathering ground site at Lake Gülpe (distance 80 km) is at present well documented. Mid-August these geese fly from the local gathering ground at Lake Rietz to Lake Gülpe. This fact has been documented by numerous observations by marked geese.

However, the maximum number of geese at Lake Gülpe is 6000. Since the geese breeding north of Lake Gülpe migrate to the Baltic Sea, a large part of the geese resting at Gülpe must come from southern areas, probably from Poland and northern Czechoslovakia. Unfortunately, this hypothesis is not documented by ring recoveries.

Only a loose cohesion exists between the geese resting at the summer gathering ground. They are mostly organized by some changeable large flocks. With the exception all 6000 geese are concentrated in one large flock on the shore. Such dense flocking only takes place during periods of good weather when the geese are absolutely undisturbed.

The daily activity in summer is characterized by an early flight to the feeding grounds (6.00 – 9.00 a.m.) followed by a period of rest and the cleaning and preening of plumage (9.00 – 17.00 h), and second feeding flight from 5.00 – 8.00 p.m. After disturbances and during bad weather periods the picture varies, and the daily rhythm and the size of the flocks changes from day to day.

Inside the large flocks the families are maintained as stable units. It is interesting to recognize, that the families which have been breed at Lake Gülpe and Lake Rietz, are not irregularly distributed between the other geese, but usually concentrate in groups. This fact leads us to the question of whether or not geese coming from different areas maintain contact inside the whole community.

Evacuation of the main summer gathering grounds

In mid-October the geese evacuate the gathering grounds. The departure doesn't take place as one take-off, but gradually, in flocks of different sizes. The question is obvious, whether geese which fly away as one flock have been growing up in the same area or have been flocked accidentally, unfortunately we still don't have an answer.

The biological importance of open communities

Though the various open communities of the Greylag Goose are formed at different times, at different places, are differently composed, and have peculiarities in ecology and circadian rhythm, they all develop in the same manner: Small flocks living at regional sites gather to larger flocks which at last form the relatively stable resting ground communities.

This survey of the different social structures of the Greylag Goose shows a very multiform picture. Many questions on mechanism of flock cohesion and structure are open. However, it seems still more important to centre further research on the question of the biological function of the different social groups. Most studies of bird flocking during the last years, has been carried out from the point of view from which the adaptiveness of flocking, is seen as a food function as well as an antipredator function (*Krebs* and *Barnard* 1980; *Drent* and *Swiestra* 1977; *Drent* 1980; *Lazarus* 1980). *Lazarus* (1980) in studies on White-fronted Geese has been found that the number of alert animals compared with the number of eating or sleeping birds, relatively decreases depending on the size of the flock, whereby the single individual benefits because in larger flocks it has more time for feeding and resting. Comparable results have been obtained in investigations on the distance between the single birds during feeding and, more distinctly the individual density per area, in relation to their behaviour. The higher the density of geese, the bigger the time budget for food uptake and vice versa.

We have planned to prove these theories in further studies of the Greylag Goose. This species seems to be particularly suitable for studying problems of sociobiology, taking into consideration its richeness of social structures in connection with an extremely high capacity of learning.

Further progress in the field of sociobiology and socioethology of the Greylag Goose could be obtained from more individually marked animals, if possible, marked on different places in the entire distribution area and an increase in the intensity of observation.

In principle, the work is directed on the solution of a problem of general importance, namely the biological importance of social life types throughout the kingdom: with that we remain totally at the beginning.

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V. EFFECTS OF VARIOUS FACTORS ON THE SIZE OF BREEDING AND RESTING STOCK OF THE GREYLAG GOOSE, *ANSER ANSER L.* IN THE GERMAN DEMOCRATIC REPUBLIC

J. Naacke

1. Introduction

Since fifteen years the Headquarter of Waterfowl Research in the GDR has investigated the population ecology of the Greylag Goose. These activities were supported by numerous amateur ornithologists from all parts of the country.

The knowledge of both stock and changes in the stock is an essential prerequisite for further ecological studies. In the years 1969, 1972 and 1977 counts of the breeding stock were taken.

About 450 permanently populated breeding sites (i.e. water or a place in the wetlands with at least one breeding pair) become known.

Earlier this year a new count of the breeding stock have carried out. The results, however, have not been completed, and so a detailed analysis will be a work for the time to come. Together with counts of the breeders in the GDR counts of non-breeders and migratory birds are taken within the framework of international waterfowl counts.

The south-western border of distribution area of the Greylag Goose in Central-Europe runs through the territory of our country. This area is almost congruent with the area of the lowlands and moraine parts, but it turns out, that the settlement by Greylags is very heterogenous *(Rutschke* and *Frädrich,* 1975); the main field is the northern interior lowland. From the evidence collected the distribution of the breeding stock in this country may be shown in Fig. 1.

The following part of the present paper will contain a discussion of the present knowledge on both the size and the composition of the Greylag stock in the GDR. This is followed by a discussion of several factors which have a certain effect on the stock.

2. Analysis of the stock

2.1 Breeding stock

In the period between 1969 and 1977 about 450 breeding sites were counted. Approximately 2900 breeding pairs have been observed every year. During the breeding season the percentage of pairs with juveniles was only 65 per cent, i.e. 1920 pairs. Table 1 shows the results gathered in the three counts mentioned above.

There was an increase in the number of pairs in some sites and a decrease in other sites. In some parts of the country the number remained constant.

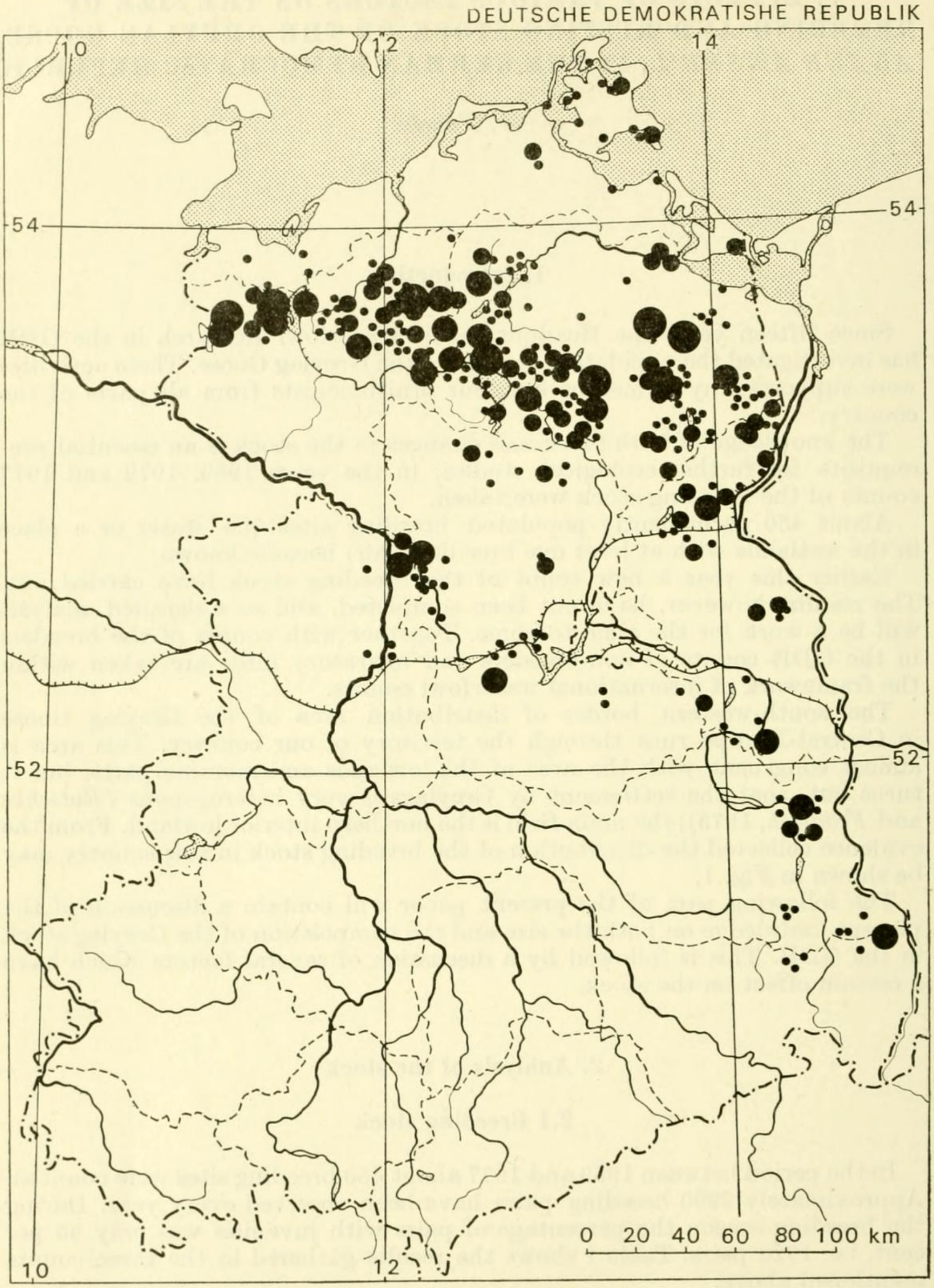

Figure V/1: Distribution of breeding sites of the Greylag Goose in the GDR 1969 – 1977, depicted in four quantities: 1 – 5, 6 – 20, 21 – 40, more than 40 breeding pairs

Table V/1.

Number of breeding pairs at the beginning of the breeding season compared to the number of pairs with juveniles in three counts (each number represents the exact counts only)

Year	Breeding pairs at the beginning of the breeding period	Pairs with juveniles	%
1969	1505	836	55.6
1972	1289	853	66.2
1977	2293	1379	60.2

Table V/2.

Number of breeding pairs of the Greylag Goose at 58 comparable breeding sites in the GDR during counts in three years

Year	Total number of breeding pairs
1969	773
1972	724
1977	1052

During 1969–1977:
Increase at 20 sites
Decrease at 17 sites
Steadiness at 21 sites

Despite considerable fluctuations from one year to the next there is an increase in the number of breeding adults in the whole distribution area of Greylags.

From 1969 to 1977 1601 successful breeding pairs have been observed with 6015 goslings at the end of the breeding period. This corresponds to an average rate of 3.8 juveniles per breeding pair over the whole period, the range is varying from 2.5 to 6.0. Altogether the differences in the juvenile rates were insignificant in the censuses of the three years.

In 1981 were counted 1363 breeding pairs at 155 sites, where 1280 pairs had breeded in 1977 (particularly results from the census of the same sites). Although the number of breeders at similar sites in many cases is different from 1977, the total stock is few increased.

2.2 Non-breeding stock

After returning from the wintering areas the non-breeders gather at the breeding area. They may be found in numerous lakes and wetlands which also serve as breeding sites for the other birds. Non-breeders live in larger open waters with homotypical conditions for their existence. Counting these flocks of non-breeders is very difficult in some places. In densely populated areas an exact determination of the stock is impossible.

At the beginning of moult migration the non-breeders gather at several favourite lakes. The largest aggregations at this time are listed in Table 3.

The total number of indigenous non-breeders was 5000 to 6000 in 1974, whereas it was only 3200 to 3500 in 1975. The number increased to 5300 birds in 1977. A direct relation may only tentatively be assumed between juvenile rate and number of non-breeders, because counts of the breeding stock are not taken annually. The correlation between the annual changes

Table V/3.

Non-breeding stock of Greylag Goose at gathering places prior to the onset of moult migration (average for several years)

Place	Number of birds
Kooser Wiesen arae (Baltic coast)	200
Barther Bodden waters (Baltic coast)	3000
Bock and Großer Werder area (Baltic coast)	150
Lakes Dambeck (Distr. Schwerin)	400
Lake Röggelin (Distr. Schwerin)	400
Lakes Putzar and Galenbeck (Distr. Neubrandenb.)	400
Lakes Ucker (Distr. Neubrandenburg)	100
Lake Tollensea (Distr. Neubrandenburg)	150
Lake Müritz, Eastern shore (Distr. Neubrandenb.)	300
Lake Müritz, Penins. Großer Schwerin	650
Lake Krakower, Obersee (Distr. Schwerin)	600
Lake Plau (Distr. Schwerin)	100
Lake Goldberg (Distr. Schwerin)	100
Lake Bolz (Distr. Schwerin)	150
Lake Gägelow (Distr. Schwerin)	220
Lake Felchow (Distr. Frankfurt a. Oder)	100
Lake Gülpe (Distr. Potsdam)	800

in chronology of the migration and the weather conditions in Central-Europe may be one of the causes for the annual fluctuations (*Frädrich* and *Litzbarski*, 1975).

2.3 The size of the breeding population of Greylags in the GDR

The total number of a population may be determined from the number of breeding pairs and other given dates, e. g. number of juveniles, number of non-breeders (*Rooth*, 1971, *Timmerman*, 1976, *Fog*, 1977).

Normally the percentage of breeders varies from 25 to 35 per cent of the stock at the beginning of breeding season and from 15 to 25 per cent at the end, taking into account exemplary mortality rates.

According to present knowlegde approximately 2000 successful breeding pairs with a juvenile rate of 3.8 each a pair give a stock of about 12 000 birds at the end of the annual breeding season. In addition, there are about 5000 indigenous non-breeders. Consequently, the stock of population in the GDR should comprise from 17 000 to 18 000 birds.

Non-breeders which flock shortly before the onset of the moult migration at a small number of gathering places should not be complety counted to the number of the local stock, as a certain percentage of them comes from other parts of Europe. Their number amounts to about 10 000 birds.

Table V/4.

The most important resting places of the Greylag Goose in the GDR in summer and autumn. Dates given in decades (I, II, III) and months

Resting place	Average maximum summer/autumn	Maximum stock autumn 1979
Rügen Island	14 000 II/Sept.	15 000 II/Sept.
Dänische Wiek	2 000 III/Aug.	5 000 III/Sept.
Darßer Bodden waters		16 000 I/Sept.
Lakes Galenbeck and Putzar	1 500 III/Aug.	4 000 I/Sept.
Lake Röggelin	1 100 III/Aug.	
Lake Mickow	500	800
Lake Krakower, Obersee	3 000 II/Aug.	
Lake Tollensee	1 300 III/Aug.	1 200 III/Sept.
Lake Müritz, Penins.		
Großer Schwerin	1 000 II/Aug.	2 200 I/Sept.
Lake Felchow	1 000 II/Sept.	1 300
Lake Gülpe	3 000 II/Aug.	6 000 I/Oct.

2.4 Stock of resting Greylags in the GDR

After the breeding season most geese leave their breeding places to gather at several main gathering grounds where they reach aggregations of considerable size after the non-breeders have arrived from the moulting sites of Scandinavia and the Netherlands. The maximum concentration is not reached simultaneously in the various places. In some places short-term changes in the stock may be observed even in summer.

The favourite resting places of Greylags in the GDR in summer and autumn are contained in Table 4 and their distribution is shown in Figure 2.

Those resting places where a maximum number between 30 000 and 40 000 birds rest serve as points of their departure to autumn migration (in recent years longer resting periods of large amounts of geese until the second half of October could be observed more frequently).

3. Factors influencing the stock

3.1 Several ecological aspects

The size as well as the amount of changes of the Greylag stock depend first of all on a complex of ecological conditions which characterize the breeding habitat and influence the population development at several waters.

A detailed characterizati onfor breeding sites of Anser and their ecological pretensions is given by *Rutschke* and *Frädrich* (1975). These authors have been explained with earlier conceptions (*Bauer* and *Glutz* v. *Blotzheim* 1968, *Hudec* and *Rooth* 1970), which have discribed very widely but not completely characteristics for breeding sites. The differentiated and precisated discussion

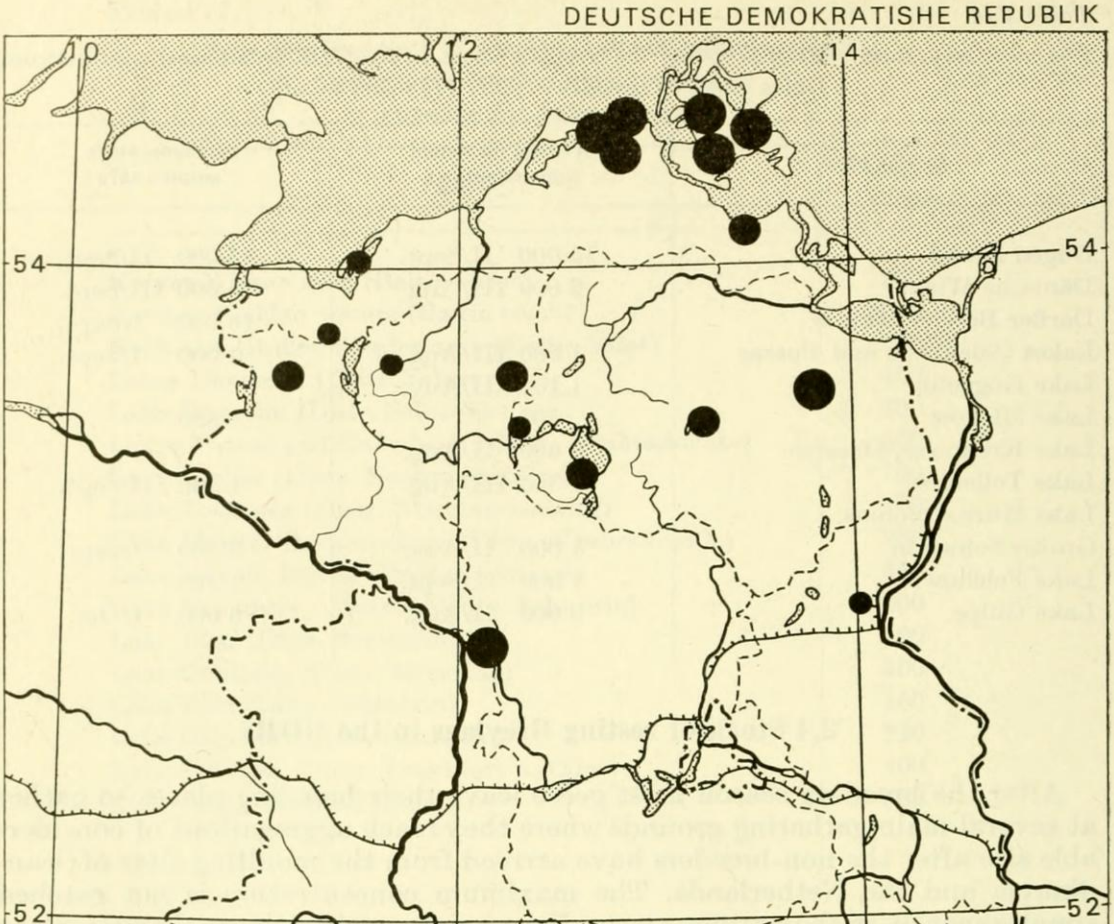

Figure V/2: Distribution of gathering grounds during summer and autumn (average maximum stock in the first half of September, given in three quantities: smaller than 1000, 1000–3000, 3000–5000 birds) of the conditions for Greylags breeding in the GDR by *Rutschke* and *Frädrich* (1975) does much still apply today, so that a further description is unnessesary.

Apart from the general state of the waters the complex of conditions which are pre-requisites for breeding is to be found in many waters of various size, depth and trophy, but this often applies only to small parts of the water or its immediate environment.

The individual features of this complex such as composition of the wetland vegetation, structure of the wetland, condition of the feeding grounds etc. may have a certain range with respect to their quality and quantity, thus results in numerous transitional stages in the composition of the breeding habitat. Thus becomes apparent when we take a look at the sites of a reat number of breeding grounds which have no characteristics related to the type of water: the Greylag nests stand right on the surface soil (dams, islets), on floating old reed or shore vegetation, on hillocks and muskrat burrows, on willow bushes and trees, sometimes in deseted nests of other birds on top of high grees (up to 13 m). In all cases the relatively indisturbedness seems to play a dominant role selecting the respective breeding place.

Very often there are difficulties in discriminating the local waters between the various types of waters (e.g. between highly eutrophic shallow lakes with a developing overgrowth, alcaline peatlands with rudimentary waters, kettle holes, remaining waters in river lowlands). Nevertheless, we tried to assign the actual breeding stock to the various types of waters as shown in Figure 3. Total numbers of breeding pairs at: coastal waters including bodden waters and islands: 40; inland lakes varying from oligo-trophic to

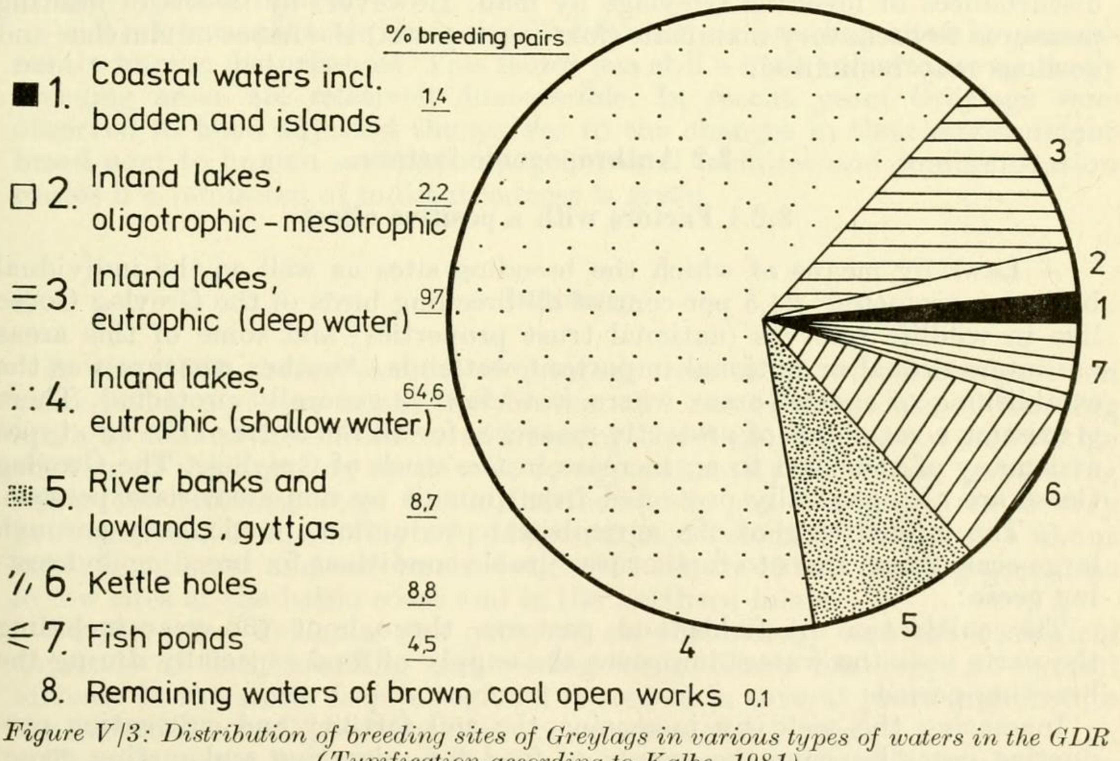

Figure V/3: Distribution of breeding sites of Greylags in various types of waters in the GDR (Typification according to Kalbe, 1981) mesotrophic type: 64; eutrophic inland lakes (deep water): 280; eutrophic inland lakes (shallow water): 1873; river banks and lowlands, alcaline peat cuttings, gyttjas: 253; kettle holes in fields: 256; fish pond areas: 134; remaining waters of brown coal open works: 3 breeding pairs.

Climatic conditions

The climatic situation may have a considerable effect on the size of the breeding stock. Investigations similar to those by *Kux* and *Hudec* (1970) have not been carried out for the stock in the GDR. However, it seems likely that there is a relation between the relatively high number of breeding pairs in 1977 and the unusually high temperatures (an average up to five degrees) in the months of February and March of that year, as the temperatures were below the average values in 1969 and consequently the number of breeding pairs was lower in many places of the country.

Changes in the water level, especially the rise of the level at the end of winter, cause heavy losses of clutches or dramatically limit the number of possible sites for nests (as in 1981). The moment of changes in the water-level is very important. Perhaps the clutches in nests an a floating fundation are more likely to survive, as such at solid soil.

Influences by predators

Predators especially corvides, Marsh harriers, White-tailed Eagles, and predatory mammals, have mainly a local effect, which often is favoured by disturbances of breeding Greylags by man. However, by means of hunting measures to predatory mammals (fox, marten etc.) the losses of clutches and goslings may be limited.

3.2 Anthropogenic factors

3.2.1 Factors with a positive effect

– Laws by means of which the breeding sites as well as the individual birds are protected: 24.5 per cent of all breeding birds of the Greylag Goose live in wildlife reserves (national trust properties) and some of this areas are international or national important wetlands. Another measure was the establishing of special areas where waterfowl is generally protected. There is existing a catalogue of protectiv measures for all the areas of the two types and many of them led to an increase in the stock of Greylags. The Greylag Geese are also generally protected from pursuit by non-authorised persons.

– The intensifying of the agricultural production, particularly through large-scale crops, leads to further favourable conditions for breeding and resting geese:

The cultivation of fields and pastures throughout the year including the parts near the waters improves the supply of food especially during the breeding period;

Increasing the yield by increasing the soil fertility and cultivating productive crops improve the supply of food for migrating and resting geese.

– Management:
Complex protective measures for waterfowl have had a positive effect on the breeding stock of the Greylag Goose. The attempts retain a state of the waters as closely to the original state as possible are comprehensive and take into account the complexity of the framework of the conditions. They include protective measures at waters, recultivation (waters in peat cuttings and in formerly brown coal open works), reconstruction of ponds (building of dams and islets). In all cases industrial and agricultural enterprises and governmental organs agree upon measures which improve the conditions for the breeding and resting of waterfowl (flat patches of shores, artificial islands, removal of overgrowth, protection from outside disturbances).

Generally, many of waters which are populated by Greylags today, are resulting of human activities (fish ponds, peat cuttings, gravel pits etc.). Favoured conditions have been developed for occurence and increase of the Greylag stock (*Rutschke* and *Frädrich*, 1975).

3.2.2 Factors with a negative effect

– Melioration measures lower the water level and lead to drying and sometime result in the loss of small breeding sites (especially kettle holes in fields). Furthermore, changes in the cultivation of wetlands near shores (because their use as pastures or haycrops are discontinued) lead to decreases in the fitness of feeding grounds and consequently to decrease in the Greylag stock. These factors, however, have only a local effect.

– Hunting does not affect the size of the stock because the annual bags of Greylags are limited.

– We known that birds are repelled from their breeding sites by permanently human disturbances. This factor has still a little importance as many breeding areas are relatively inaccessible. In recent years Greylags were observed to have adjusted themselves to the changes in their environment breed next to human settlements, agricultural facilities and communication routes if a minimum of indisturbedness is given.

Summary

In the GDR, several counts of Greylags were taken within the past ten years giving a survey of the distribution and size of the stocks of breeding birds as well as non-breeders and resting Greylags. At present knowledge the size of the breeding stock runs to approximately 2900 pairs populating about 450 breeding sites, which distribution in the breeding area is very heterogenous. The number of indigenous non-breeding Greylags is about 6000. In summer and autumn a stock of 35 000 to 40 000 Greylag geese rest in few sites at the baltic coast and in the northern inland.

Furthermore, evidence was gathered on the biology and the ecological demands of both breeding and resting birds. There has been an overall increase in the stock despite regional decreases in several years and despite the fact that not all breeding sites are occupied every year.

There have not been enough studies on the vast complex of factors influenc-

ing the sizes of the stock of breeders and resting Greylags. This is also true of the knowledge of the ecological factors at many of the local breeding sites.

There is, however, a preponderance of factors with a favourable effect on the stock, which the influence of human activities is the most important factor. The effectiveness of these factors is enhanced by legal measures. Negative factors only affect stocks in some localities or regions and may be limited to those areas.

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VI. ON THE SITUATION OF *ANSER ANSER* IN THE FEDERAL REPUBLIC OF GERMANY

A. Rüger

1. Occurrence

Anser anser is practically restricted to Schleswig-Holstein as a breeding species in the Federal Republic of Germany. Occasional records west of the River Elbe nowadays refer almost exclusively to attempts to introduce the species. In this context occurrences at Lake Dümmer and the Riddagshaus Ponds should be mentioned.

The breeding distribution of *A. anser* in Schleswig-Holstein is restricted to the hilly areas in the east. The main points of concentration are the coastal lakes of the island of Fehmarn, the Lauenburg border wetlands and especially the east Holstein lake area. According to an investigation by *Knief* (1977), nearly two thirds of all breeding sites in 1977 were in the east Holstein lake area.

In Schleswig-Holstein, breeding sites are predominantly on ponds and lakes; when the water-level is sufficient, breeding also occurs in bogs and marshes. Islands are preferred and the nests are often concentrated like colonies. Occasionally breeding is recorded at sites some distance from water. An essential requirement is that grazing areas with short grass should be available for raising the young.

2. Population size

In the last century there were still natural occurrences of breeding birds west of the Elbe. These came to an end in the first half of this century.

In Schleswig-Holstein, there was also a decrease at the end of the last century (*Rohweder*, 1875). However breeding probably never ceased altogether (*Beckmann*, 1951). According to *Bauer* and *Glutz* (1968) about 170 pairs bred in Schleswig-Holstein in the mid 1960s. The real number of breeding birds was probably higher, however. In the 1970s, a distinct increase has taken place. *Knief* (1977), in a precise study of the population, found 657 pairs with young in 1977, excluding the small population in the Lauenburg border area. The average brood size was 4.1. Altogether, *Knief* estimated the number of breeding pairs in that year at about 1000, of which 700 (70%) were successful (Table 1).

A count in 1978 gave a slight decrease in pairs with young – about 560 excluding Lauenburg, with brood size of about 4.3 per pair. The figure for 1980 was 538 successful breeding pairs (excluding Lauenburg) with a brood size of 4.7 per pair. Studies in 1981 showed a distinct decrease in the breeding population to 410 families, excluding Lauenburg.

Table VI/1.

Population of Anser anser in Schleswig-Holstein

Year	Families	Brood size	Non breeders (May)	Total population		
				August	September	October
1977	657	4.1	2750	8850	6750	1200
1978	560	4.3		7200	7550	1350
1979			2600	8000	6400	2400
1980	538	4.7	2300	6750	6500	1750
1981	410	4.0		6050*	5200*	4500*

* = Excluding Lauenburg breeders

3. Reasons for changes in population size

3.1 Hunting

It is not clear how far the increase in the population in the 1960s is related to restrictions in the open season. Until 1967, *A. anser* could be hunted from 1 August to 25 January. From 1967 the open season was limited to the period between 1 October and 15 January. As a result the species was hardly affected any more by hunting, since as a rule the geese leave Schleswig-Holstein in early October. In 1977 a new open season was introduced, whereby *A. anser* could be shot in Schleswig-Holstein from 1 to 31 August and from 1 November until 31 December. Restriction of shooting to the period before 1000 hours was an innovation. According to rough estimates about 600 *A. anser* have been shot each year since the introduction of the new hunting season in August, while between 1967 and 1977 about 300 geese a year were shot.

3.2. Agriculture

Agricultural measures such as removal of hedges have probably had a certain positive effect on the quality of goose areas in the hilly parts of east Holstein. It is not clear however to what extent the reduction of grassland from 25.4% of the agricultural area in 1970 to 22.4% in 1979 has had a negative effect. At present there is still extensive grassland by lakes and ponds for raising young.

3.3. Tourism

Tourism acts as an increasingly important burden. Schleswig-Holstein is the sixth most popular destination for German tourists. The number of nights spent by tourists in Schleswig-Holstein increased from 15.9 million in 1960/61 to 33.2 million in 1979/80. In the Plön district, which is very important for *A. anser* 1.9 tourist/nights were recorded in 1979/80. The increase in windsurfing on the Schleswig-Holstein lakes since the end of the 1970s should be mentioned. It is obvious that *A. anser's* early breeding season is the reason why no very marked effects on the breeding population have so far been observed. At the beginning of the tourist season (end of May) the young are, as a rule, nearly full grown. Furthermore *A. anser* shows a strong capacity to learn how to avoid disturbance.

3.4. Other reasons

Overall, the reasons for the changes in population size of this species are probably to be found in the migration and wintering areas. This seems to the case with the decrease in breeding pairs in 1981, which is clearly connected with conditions in the Spanish wintering-area (Castroviejo *in litt*).

4. Non-breeders

Knief (1977) gave the non-breeding part of the population as 68% of the whole. According to available counts from 1977 to 1980, this in May represents about 2500 birds.

As soon as the young birds are able to fly adequately – at the end of June – a concentration of *A. anser* begins. From the middle of August, *A. anser* is really only to be found at particular summeringsites. Knief's figures for July suggest that the local breeding population is joined by non-breeders returning from their moulting places and by further birds on passage. Numbers of *A. anser* are at their highest in Schleswig-Holstein in August, with over 8000 birds (Table 1).

5. Conflicts with agriculture

Reduction of agricultural production occours in cereal fields and grassland.

In the early spring, after the arrival of the geese, cereal fields are visited, particularly by non-breeders and birds on passage. Grazing of the cereals may then restrict their growth. Additional application of fertilizer or loosening of the ground following excessive trampling in wet weather has in some places been necessary.

The breeding birds graze predominantly on grassland, but also on cereal fields if they are very close to water. *Knief's* studies however only revealed serious damage in exceptional cases.

When the geese forage on grassland near the shoreline of breeding area, there are no doubt reductions in production which however are generally restricted to the immediate area of the shore. Competition with cattle grazing in the same area is as a rule tolerated by agricultural interests, especially as the geese often exploit islands and shores which are not used for agriculture. There has been no proof of goose droppings affecting grazing by cattle.

When the young geese have learnt to fly, feeding flights to cereal fields occur. Damage is then caused, particularly in standing winter barley but also in fields of rye and wheat. In his investigation of this subject, Knief reached an estimate of 22 000 DM for Schleswig-Holstein in 1977. As soon as stubble fields are available, they are regularly preferred.

Table VI/2.

Recoveries of the 222 A. anser ringed in Schleswig-Holstein in 1977

	1978	1979	1980	1981	Total
Found dead	1	2		1	
Schleswig-Holstein					11
Shot	4	2	1		
Found dead					5
France					
Shot	1	1	2	1	
Found dead					8
Spain					
Shot	4		1	2	
	10	5	4	5	24

After the resowing of the cereals, *A. anser* feeds on winter cereal fields until the departure for the winter quarters. According to agricultural specialists, this grazing definitely leads to a strengthening of the plants, even with modern strains of seed.

6. Ringing

In 1978, a total of 222 *A. anser* was ringed, 100 of them with a further broad white plastic leg-ring, on which a black digit was engraved. It was not possible to analyse the results of this project, since very few rings were read. Twenty-four of the ringed birds have been recovered. Five were found dead, while the others were reported as shot. Table 2. shows clearly that the major part was shot in Spain.

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VII. SHORT COMMUNICATION ON *ANSER ANSER* IN THE NETHERLANDS, 1970 – 1980, WITH SPECIAL REFERENCE TO OOSTVAARDERSPLASSEN

W. Dubbeldam – E. P. R. Poorter

The continental population of *Anser anser* in western Europe, that winters mainly in the Marismas of the Guadalquivir in southern Spain, increased from 30 000 birds during the 1960s (*Rooth,* 1971) to at least 50 000 in November 1973 (*Dubbeldam,* 1978), and to at least 80 000 in December 1980 when this number was counted in the Marismas of the Guadalquivir (*Luis Garcia Garido,* pers. com.).

The Netherlands, especially the Oostvaardersplassen, a large *Phragmites* marsh in the new Ysselmeerpolder of Southern Flevoland, play an important role in the flyway of this population during nuptial and postnuptial migration and as a moultingplace for non-breeding birds. Suitable ecological conditions and the absence of goose hunting in the Oostvaardersplassen and adjacent agricultural area could have favoured the increase in the population.

During the 1970s, ecological conditions for *Anser anser* in the Netherlands altered. Their major haunts during nuptial and postnuptial migration in the Hollands Diep-Haringvliet in the southwestern part of the Netherlands became of lesser importance after this estuary was dammed off from the sea in 1970. The extent of the stands of rushes (*Scirpus maritimus* and *Scirpus lacustris*) decreased considerably. These stands provided shelter for roosting geese and the underground parts of the plants formed an important food stock.

Table 1 demonstrates the alteration of the percentages of geese in different types of feeding habitat in the Southwestern Estuary in the Netherlands.

Although the geese were forced to change their feeding habits in the area their numbers during autumn migration and winter are at the same levels of 8000 – 10 000 and 3500 – 4000. The number of geese during the period of spring migration, however fell from 10 000 to 1000 – 1500 (*Ouweneel,* 1981).

The Ysselmeerpolders of North East Polder (pumped dry in 1942) and Eastern Flevoland (pumped dry in 1957) were important haunts for *Anser anser* during the period between the drainage of the bottom of the former lake and the reclamation and cultivation of the soil. Extensive areas of temporary marshland with adjacent extensively cropped state farmland formed an attractive combination of feeding and roosting habitat. When the last reclaimed polder of Southern Flevoland had been pumped dry in May 1968 a permanent extensive marshland was created since 5000 ha. of *Phragmites* marsh and shallow lakes were preserved from drying out and reclamation in 1973. This marshland and adjacent statefarmed land evolved during the following years into an outstanding area for *Anser anser* (*Dubbeldam,* 1978). Maximum numbers of geese during the period of postnuptial migration are between 20 000 and 30 000 (42 000 in October 1979). Depending on the occurrence of frost

Table VII/1.

Proportion (%) of Anser anser on various types of feeding habitat in Southwestern Estuary in the Netherlands (Draayer, 1967 *and Ouweneel,* 1981)

		1964–65	End of 1970s
Autumn migration period	Stands of rushes	32	0
	Grass	16	10
	Sugar beet	52	90
Wintering period	Stands of rushes	32	0
	Grass	68	100
	Sugar beet	–	–
Spring migration period	Stands of rushes	100	0
	Grass	0	100
	Sugar beet	0	0

some hundreds (sometimes up to 6000) geese stay here during winter. Peak numbers of 10 000 to 15 000 are present during the period of nuptial migration.

During the first years the food of the geese consisted mainly of *Phragmites australis* and *Typha latifolia.* The preference for rhizomes of *Typha latifolia* was distinguished as a new feeding habit (*Dubbeldam,* 1978). In order to prevent the marsh from becoming completely overgrown with reeds, the water level in the marsh was raised in 1975. The aim was twofold: to slow down the germination of *Phragmites* and *Typha* from seed and to enable the geese to wash out the roots of these plants from the clay-soil by dabbling and to enable the birds to wash their bills while eating. As a result of this measure to control the vegetation, *Typha latifolia* was nearly exterminated from the area and dense reedstands were thinned out as well as reduced in total area. Resulting from the disappearence of *Typha latifolia* – with its relatively shallow growing rhizomes an easily obtainable food – the geese partly shifted their feeding area to surrounding stubble fields with spilled cereal grains and barley seedlings and to fields with young winter rape plants in autumn and to grass ley and barley and wheat crops in winter and spring (Table 2).

The Oostvaardersplassen have become the moulting place for one of the largest flocks of non-breeding *Anser anser* in western Europe in the last five years. More than 6000 of these birds pass the period of wing moult in the area. The food consists mainly of grass during the one or two weeks prior to moulting and of leaves of *Phragmites* during the moulting period. The numbers of geese on the other two moulting places in the Netherlands, Steile Bank (peak numbers of 2000 to 5000 geese in the start of the 1960s) and Ventjagersplaten (peak number of 1100 in the end of the 1960s) have greatly decreased.

Since 1909 when *Anser anser* disappeared as a breeding-bird in the Netherlands it was found breeding from 1948 up to and including 1952 and in 1962 and 1963 in the Ysselmeerpolders as the only place in the Netherlands (*Dubbeldam,* 1978).

Table VII/2.

Proportion (%) of Anser anser in various types of feeding habitat in Flevoland during autumn and spring migration before (Aug. 1972 – April 1975) and after (Aug. 1976 – April 1980) the water level of the marshland was raised

	Marsh-land	Grass-ley	Cereals	Stubble-fields	Winter rape	Ploughed
AUG. – DEC.						
1972 – 1974	60	2	1	19	9	8
1976 – 1979	10	1	4	41	38	8
JAN. – APR.						
1973 – 1975	83	9	8	0	0	0
1977 – 1980	46	23	25	1	3	2

Since 1970, two years after Southern Flevoland had been pumped dry, *Anser anser* has become a breeding bird of the new marshland. The number of pairs of breeding birds in the Oostvaardersplassen has increased to about 200 since then. From this population the geese established themselves as breeding birds in a number of other localities in the Netherlands. Apart from these spontaneous settlements, totalling about 250 pairs, *Anser anser* was introduced in the province of Friesland (about 70 pairs now) and settled as a breeding bird in Zeeuws Vlaanderen from ancestors escaped from Zwin aviary on the Belgium border. *Anser anser* is a key factor in the ecosystem of that open *Phragmites* marsh of the Oostvaardersplassen (*Poorter*, 1979). Without any natural or artificial control of the vegetation, the open spaces in the marshland would quickly be covered by *Phragmites australis* and other marshplants and the marsh would lose its function as a place for shelter and food to many waterfowl species.

The main effects of the activities of the geese on the vegetation are:

– preventing the extension of the marsh vegetation by seedlings of *Phragmites* and *Typha*. Seedlings that have been massively germinated on the naked mineral soil during dry summers are removed by the geese in autumn;
– repelling the vegetational extension of *Phragmites* and locally forcing back *Phragmites* stands in summer.
  Stems and leaves of *Phragmites* are intensively grazed and damaged by the geese in summer during their moulting period. Following recovery of the plants in July and August the fresh leaves and stems are consumed or damaged again in September and early October.
– Forcing back the vegetation of *Phragmites* and *Typha* in autumn and winter. Roots and rhizomes of these plant species are consumed by the geese in autumn and winter.

Apart from vegetation control, the geese could play an important role in the ecosystem of the marsh by fertilizing the water and feeding the detritus food chain. About 80% of the consumed plant material is defecated smashed and undigested into the water (*Owen*, 1972).

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VIII. THE GREY-LEG GOOSE IN HUNGARY

Cs. Aradi – G. Kovács

The Grey-leg Goose *(Anser anser)* has a discontinuous distribution in the Palearctic – according to its ecological requirements. It is missing from vast areas due to human activity or its population is decimated.

The Karpathian basin and in it Hungary is an important breeding area for the Grey-leg besides, one should not forget its meaning for migration though data are rather lacking here.

There are two main breeding grounds in the Karpathian basin – the Hortobágy and the lake Fertő or Neusiedler See. The facts show that even on the most stabile breeding grounds there are high – up to 100% – oscillations in population (Table 3). These oscillations result from re-grouping. In our opinion there is a dinamical exchange among breeding grounds in the Karpathian basin, there is no sign for isolation and thus the population is genetically unanimous.

In Hungary the Grey-leg was a frequent species up to the late last century. They frequented especially lake Fertő, the Ecsed swamps, Nagyberek and Sárrét.

In the reduction of the Grey-leg in Hungary the decisive role had the drainages, river-regulations and besides and later the intensification of the agriculture which changed not only the breeding grounds but even the feeding ones and last but not least the hunting.

During the XIXth century many breeding grounds ceased to exist e.g. Ecsed swamps. Habitats favourable ecologically and ethologically were running out the population was decimated.

There were but some more extensive near-natural habitats ensureing their survival. In this critical period a slow adaptation could have taken place which later enabled the population to increase, a process going on even today. This adaptation is felt best in a broadening ecological valency. The human activity meant not only destruction to the Grey-leg but also new possibilities. Especially the positive effects due to building of bigger reservoirs and fishponds are to be mentioned.

During the decades after the turn of the century the deep was reached, then came a long stagnation and later – as result of nature protection efforts – arrived the slow recovery. This is felt already in the fifties and became balanced and more determined in the sixties. The beginning of this period was marked by the existence of only four breeding grounds: lake Fertő, lake Velence, lake Kisbalaton and Hortobágy. In 1965 *Sterbetz* estimated that the Hungarian population is 250 pairs, the bulk of it is described – 140 pairs –

from the Hortobágy – halastó (fish-pond), Kunkápolnás swamp. These areas today belong to the Hortobágy National Park.

Present study is a summary of the data of the last decade as to breeding, migration, movements of the Grey-leg, in case of population change evaluation with regard to earlier information.

The Hortobágy area, investigated by the authors is considered most detailed but not omitting the characteristics of other important breeding grounds in the country – lake Fertő, Velence, Kiskun National Park, lake Kisbalaton.

For providing information we express our thanks to following colleges: *Bankovics Attila* (Ornith. I. OKTH), *Bécsy László* (Állatvilág zool. magazin), *Kárpáti László* (Sopron, Forestry Univ.), *Schmidt Egon* (Állatvilág), *dr. Sterbetz István* (OKTH Ornith. Inst.).

Breeding habitat characteristics in Hortobágy N. P.

The Hortobágy N. P. affords breeding possibilities for the biggest population in the country on its 70 000 ha area, taken into account also the attached reserves. The stable and temporary swamps, fish-ponds, arable land in the rand zone lying scattered in the vast puszta provide favourable conditions for the Grey-leg to breed.

The nests are found predominantly in old reed *(Phragmites communis)*, reedmace *(Typha angustifolia, T. latifolia)*, rush *(Schoenoplectus tabernaemontani)*. The distribution of nests according vegetation is shown in Table 1.

It settles predominantly in the rank zone, in clearings, near open water, avoiding dense uninterrupted vegetation.

Table VIII/1.

Distribution of Grey-leg Goose nests examined in Hortobágy N. P. according vegetation units

Vegetation	Nests	%
Phragmites communis	92	73.6
Typha angustifolia et latifolia	9	7.2
Schoenoplectus tabernaemontani	17	13.6
Bolboschoenus maritimus	4	3.2
Glyceria maxima	2	1.6
Agrostis stolonifera Beckmannia eruciformis	1	0.8

Table VIII/2.

Species nesting in colony with Grey-leg Goose

	Nests	
	central	rand
Purple Heron *(A. purpurea)*	1	6
Spoonbill *(P. leucordia)*	2	10
Great White Egret *(E. alba)*	1	1

It was found nesting frequently with other species. With regard to its early breeding this is, however, not a real proof for its social breeding tendency (see Table 2).

According to our observations – though there are no data from the ethologically critical period of colony forming – there is only insignificant interspecific intolerancy, the heterotypical colony-forming tendency of the Grey-leg is to be regarded neutral.

When regarding the colony-forming on the Hortobágy there are two phenomena worth to mention to be considered at any rate when organising active protection of this species.

1. Within traditional breeding grounds the use of ecologically different nesting places.
2. Use of temporary marshes when water-stand is low.

The first signs of the population increase were recorded on the fish-ponds. This was repeated in the Kunkápolnás swamps. The increase is perpetually becoming quick but at the same time an other phenomenon becomes apparent – the breeding population oscillates on both places.

The beginning of the oscillation is in terms of time identical – and may be to be explained – with settlement in new habitats. In the seventies the optimal breeding grounds were saturated and the Grey-leg appeared in temporary marshes and smaller reed-bulrush patches.

Table 3. informs on the present Grey-leg population according habitats. Besides the breeding grounds indicated there are also other ones in temporary waters, smaller marshes.

With regard to these facts the population of the National Park may be estimated as 400 – 500 pairs.

The Grey-leg arrives home very early, frequently before other species and possibly these are of the local population.

Spring arrival – 1973. 02. 24.
1974. 02. 01.
1975. 02. 16.
1976. 02. 22.
1977. 02. 06.
1978. 02. 12.
1979. 02. 12.
1980. 02. 05.
1981. 02. 08.

Table VIII/3.

Present Grey-leg Goose population of Hortobágy

1. Fish-ponds

	Minimum	Maximum
Hortobágyi halastó	40	80
Fényes tavak	6	12
Csécsmocsári tavak	6	15
Derzsi tavak	5	8
Elepi tavak	5	15
Kónyai tavak	8	15
Ohat-Gyökérkúti tavak	5	10
Kungyörgyi tavak	3	8
Borsósi tavak	8	12
Virágoskúti tavak	20	30
	109	205
	average 157	

2. Stable swamps

	Minimum	Maximum
Kunkápolnási mocsár	40	100
Jusztus-Feketerét	15	30
	55	130
	average 92.5	

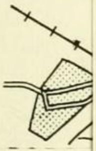
3. Temporary swamps

	Minimum	Maximum
Nyári járás-Fecskerét	5	14
Angyalházi Nagyrét	10	15
Csikósér—Nagyág-ér	3	5
Polturás lapos	1	6
Zámi mocsarak	8	15
Ágotai mocsarak	3	5
Kecskéspusztai mocsarak	15	25
Boca lapos	8	10
Feketeér – Liba lapos	6	10
Szelencési vizek	2	8
Dankó mocsár	10	15
Máta-pusztai mocsarak	1	3
Kincses lapos	0	2
	72	133
	average 102.5	

4. *Running waters, channels*

A HO

Nyá



A HORTOBÁGYI NEMZETI PARK

Nyárilúd fészkelőhelyek a HNP területén

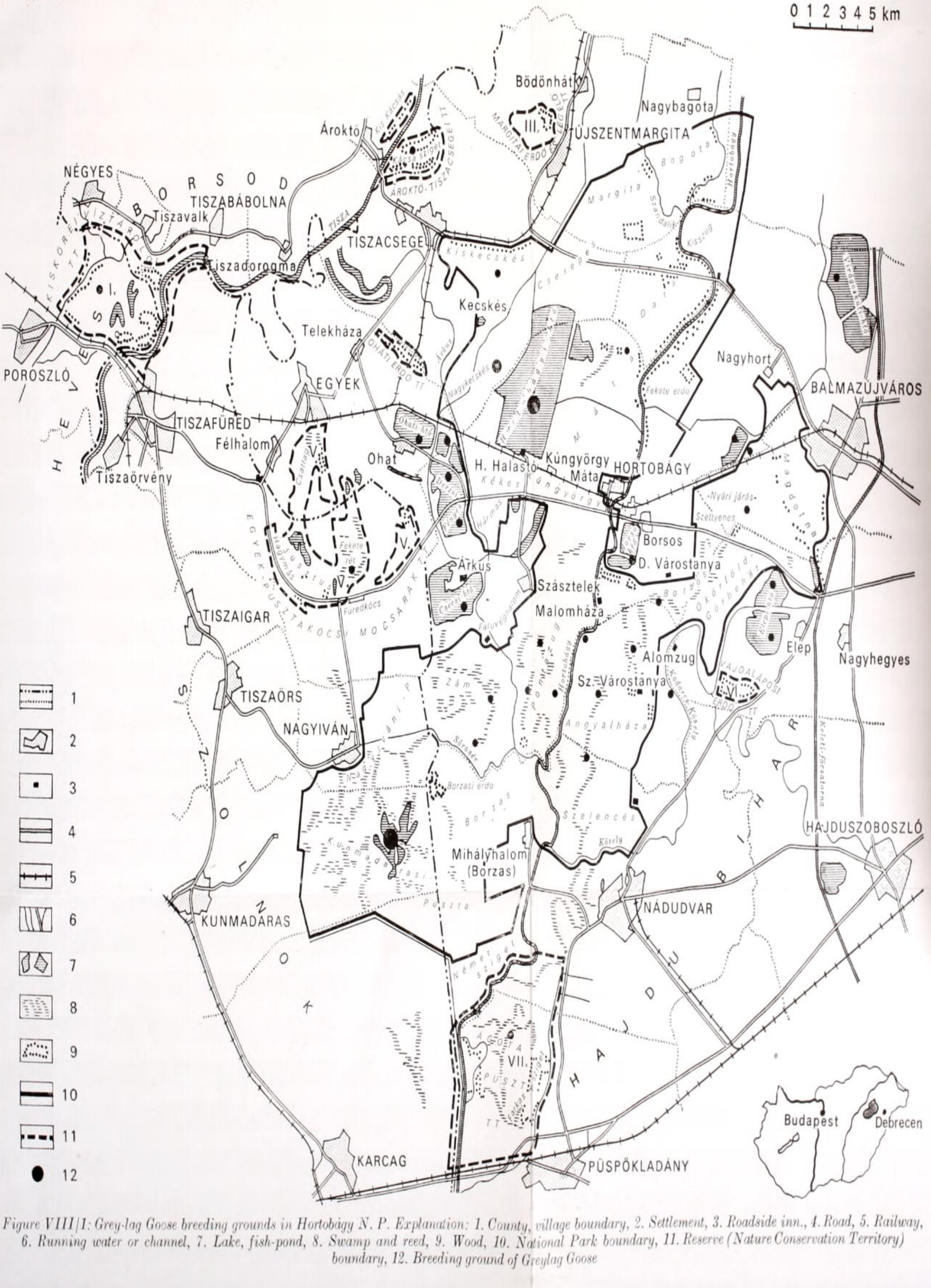


Figure VIII/1: Grey-lag Goose breeding grounds in Hortobágy N. P. Explanation: 1. County, village boundary, 2. Settlement, 3. Roadside inn., 4. Road, 5. Railway, 6. Running water or channel, 7. Lake, fish-pond, 8. Swamp and reed, 9. Wood, 10. National Park boundary, 11. Reserve (Nature Conservation Territory) boundary, 12. Breeding ground of Greylag Goose

Table VIII/3.

Present Grey-leg Goose popul

4. Running waters, channels

	Minimum	Maximum
Hortobágy folyó	2	5
Kadarcs – Kösely	8	15
	10	20
	average 15	

5. Reservoirs

	Minimum	Maximum
Tiszafüredi Madárrezervátum (Tisza II)	3	8
reserve Tisza II. not protected	30	50
	33	58
	average 45.5	

6. Inundation areas, oxbows

	Minimum	Maximum
Nagy Kácsás	2	10

After arrival the pairs occupy their breeding grounds at once. Bigger flocks are seen only exceptionally – as on 1981. February 28th on the Fish-pond 500.

The pair-bond exists probably even during migration. During early breeding period the geese are very active, display-flying near the future nest. The flocking tendency disappears. The activity of pairs decreases quickly during nest-building and especially during egg-laying. At this time – with some delay in contrast to breeding ones – the immatures display territorial activity. It declines also in them gradually and the immatures displaying territorial and even partially mating behaviour, form flocks. These flocks arrive together to feeding grounds, but separate from the breeding pairs.

The Grey-leg clutch was formed of 4 – 6 eggs similar to literature data. The families have mostly 3 – 4, infrequently 5, rarely less than 3 young. In one case a pair having 11 young was observed, but in other ones only two young hatched.

In the Grey-leg the territorial activity is not strong which may have connection to its high sociability in other life-cycles. Agressivity is shown most frequently when occupying nesting-place or in case of too near neighbours. Agressivity becomes more frequent on the feeding grounds, but this is reduced – especially when in formation – to some ritualised movements, ensureing ranking and occupation of feeding grounds.

It was observed that foot-pathes led from some nests to the nearest feeding grounds.

During breeding and rearing – on undisturbed areas – they do not fly much, except the early and late hours. On these occasions it is possible that the male joins the female. Between the nest and the feeding grounds they prefer to travel on foot or swimming. The male has predominantly guarding duty, but leaves frequently its duty for longer periods.

For the birds nesting in natural surroundings the feeding grounds are the meadow zones of the swamps and the nearby natron puszta. The swamp breeders feed on leaves of aquatic plants of the clearings (Stratiotes aloides) too.

In undisturbed feeding areas the geese may be seen during all the day, but first of all during the time mentioned. It was observed that until spring when the cottages were not yet populated or there were no animals the geese fed in the open far from the swamps even right at the cottages. After repopulation they changed feeding grounds and even feeding time preferring from then on the early and late hours.

The fish-pond nesters arrive to feeding grounds – fish-pond dams – rather at dark, even at midnight. The flying young attend the dams nondeterred during daytime, but the moulting adults hide in the reed.

When the young hatch the families prefer the nearest feeding grounds. As the young grow they increase the action area, but never exceeds 400 – 500 ms. They leave protected reed-bulrush rands only as far as 50 – 100 ms. If they feel danger they disappear into the thicket, the minimum escape distance in the open means at best 300 – 400 ms. If they are surprised in the open, the adults – sometimes even the young – lay on the earth with neck streched – as a breeding female on the nest in case of danger.

If the young are now approached the adults may escape feigning injury (ambivalent behaviour in conflict) or circle overhead, or fly into the reed calling the young. In a case the majority of adults took to flight and only some remained to lead the assembled young into the reed.

As the young grow the nest-centralised territories are abandoned and the geese gather near the best feeding areas. The socialibility increases as the young begin to fly and then together with the immatures the flocks gather remaining until mid-autumn. The two main gathering places of the Grey-leg are the big fish-pond (Halastó) and the Kunkápolnás marshes. Already late July or in August flocks by hundreds or 1 – 2 thousand gather here. They flight between the daytime feeding places and the sleeping waters becomes regular (Table 4).

The biggest flocks are generally seen in the dry, emptied fish-ponds. If on the fish-ponds over 1000 were observed they gathered in the dry ones. This is an ideal resting place for them as a starting point to the feeding grounds, the puszta. At this time the action area increases. It is remarkable that, although there are many similar feeding grounds, they prefer certain areas since decades. This phenomenon as a result of learning may be important when considering protection.

During spring and especially autumn they are observed frequently in

Table VIII/4.

Gathering data from Hortobágy

	Area	Numbers
1974		
26. 07.	Hortobágy – Halastó	179
05. 08.	Hortobágy – Halastó	300
15. 08.	Hortobágy – Halastó	300
1975		
04. 07.	Hortobágy – Halastó	150
13. 07.	Hortobágy – Halastó	236
16. 07.	Hortobágy – Halastó	700
17. 07.	Hortobágy – Halastó	783
05. 09.	Kecskés	727
09. 09.	Pentezug	160
10. 09.	Zám	110
14. 09.	Hortobágy – Halastó	907
1976		
29. 08.	Hortobágy – Halastó	470
04. 09.	Nagyiván	150
06. 09.	Kecskés	120
15. 09.	Nagyiván	113
09. 10.	Darvas	300
10. 10.	Hortobágy – Halastó	850
14. 10.	Nagyiván	800
16. 10.	Hortobágy – Halastó	850
17. 10.	Kunmadaras	300
09. 11.	Nagyiván	1300
12. 11.	Nagyiván	1500
18. 11.	Zám	400
23. 11.	Kunmadaras	500
25. 11.	Darvas	221
1977		
10. 07.	Hortobágy – Halastó	750
23. 07.	Csécsi tó	260
25. 07.	Hortobágy – Halastó	850
12. 08.	Cserepes	240
24. 08.	Nagyiván	500
26. 08.	Hortobágy – Halastó	600
07. 09.	Darvas	800
17. 09.	Halastó	1300
06. 10.	Kis-Kecskés	250
08. 10.	Nagyiván	500
14. 10.	Darvas	600
15. 10.	Halastó	400
05. 11.	Kecskés	300

Table VIII/4.

	Area	Numbers
1978		
01. 07.	Csécsi tó	150
20. 08.	Nagyiván	300
12. 10.	Csécsi tó	400
1979		
03. 08.	Hortobágy – Halastó	kb. 5500
18. 08.	Hortobágy – Halastó	500
30. 08.	Hortobágy – Halastó	1200
05. 09.	Hortobágy – Halastó	1000
16. 09.	Nagyiván	200
18. 11.	Feketerét	120
23. 11.	Darvas	400
1980		
16. 09.	Hortobágy – Halastó	220
28. 09.	Hortobágy – Halastó	360
17. 11.	Hortobágy – Halastó	kb. 3000

mixed groups with other geese, frequently in smaller units inside the big flocks. Data on the migration of other more northerly populations are very vague thus there is no possibility to evaluate the habitats of the country in this respect. For all that has to be mentioned that there are reports of big migrating flocks from areas where its breeding is unclear or rare (Tata). The flocks observed, however, do not exceed the population of breeding areas and so it is difficult to tell – without ringing – where they belong.

Winter data

In winter they appear on the Hortobágy temporarily or during thaw or milder periods of 1 – 2 weeks in White-fronted Goose *(Anser albifrons)* flocks.

Kunmadaras puszta	1976. 12. 18.	7
Darvas (lake)	1977. 12. 09.	7
Csukás	1979. 12. 08.	69
Kunmadaras puszta	1980. 12. 31.	2

Other breeding grounds in Tiszántúl (east of r. Tisza). There are breeding data from other areas of Tiszántúl. It is a pity that many territories are not known and thus there is no possibility to make a real picture. South of the Hortobágy in C. Bihar it breeds scarcely or by occasion (Derecske, Konyár, Esztár, Pocsaj, Bojt).

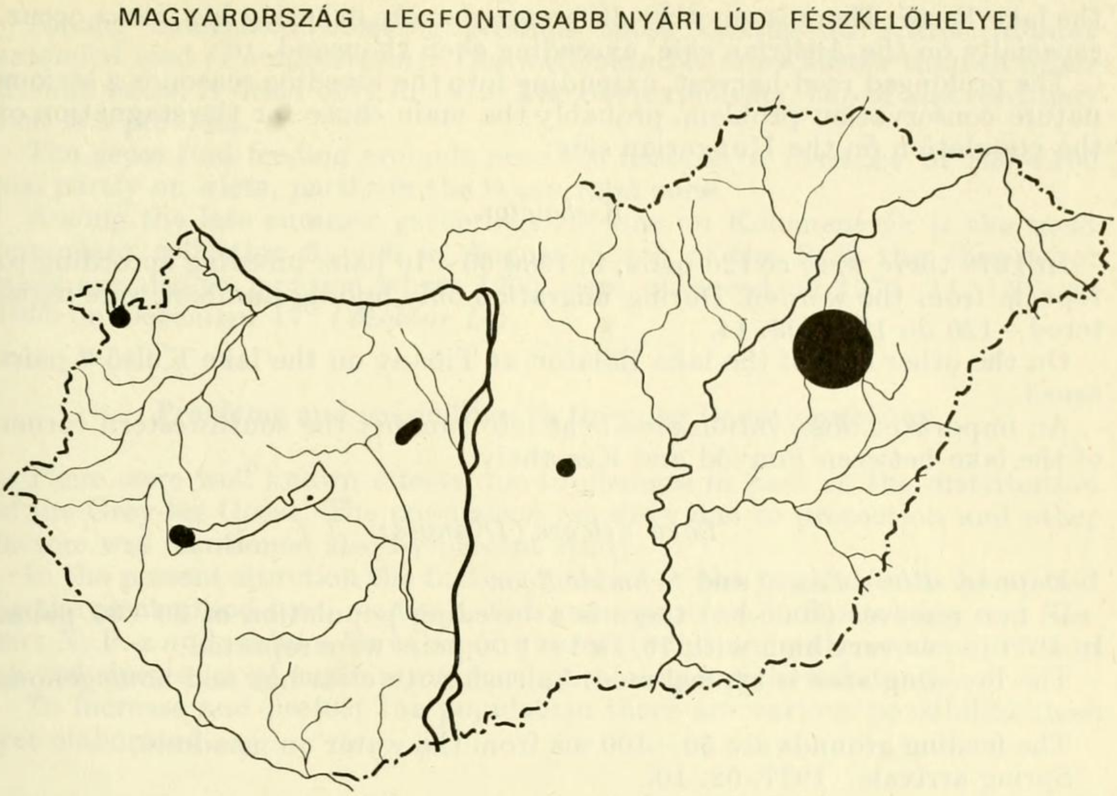


Figure VIII/2: Important breeding grounds in Hungary

Regular breeding was stated only between Hosszúpályi and Konyár on the Nagyfehértó and between Konyár and Esztár in the reeds. The population is roughly 5 – 6 pairs, during migration and gathering 60 – 70 were observed only.

It is a regular breeder on the fish-ponds at Biharugra visiting it during migration in bigger flocks – 280 on 1972. Nov. 17th.

At Kardoskút Co. Békés it is a regular migrant sometimes in bigger flocks – 150 on 1970. Oct. 18th *(Sterbetz).*

Important breeding grounds in Hungary

Lake Fertő

According *Kárpáti László* the breeding population of the lake is around 500 pairs, but of it only 50 breeds on the Hungarian side.

Its typical habitat is the closed or partly interrupted reed. It occurs not so frequently in reedbulrush associations.

On occasions nests on *Ondatra cibetica* cones are built. The feeding grounds of the families are on meadows *(Agrostidetum)* near the chanel dams and Caricetum distantis association in the rand zones.

In contrast to Hortobágy it occurs the whole year round even in winter on the lake Fertő. There is an other difference namely in spring big flocks occur, especially on the Austrian side, exceeding even thousand.

The prolonged reed-harvest, extending into the breeding season is a serious nature conservation problem, probably the main cause for the stagnation of the population on the Hungarian side.

Kisbalaton

In 1979 there were cc 120 pairs, in 1980 60 – 70 pairs breeding according to reports from the warden. During migration only middle numbers were registered – 120 on 1981. 03. 14.

On the other side of the lake Balaton at Tihany on the lake Külső 3 pairs breed.

An important observation area is at late summer the southwestern corner of the lake between Fonyód and Keszthely.

Lake Velence (Dinnyés)

Data by *Bécsy László* and *Schmidt Egon.*

In two reserves (1000 ha) there is a breeding population of 30 – 35 pairs. In 1977 it was very high with 70. In 1981 90 pairs were reported.

The breeding area is typical reed, bulrush with clearings and homogenous reed.

The feeding grounds are 50 – 100 ms from the water on meadows.

Spring arrivals 1977. 02. 10.
1979. 02. 17.
1981. 02. 03.

The clutches consist of 3 – 4 eggs resp. young, but there are many with only two young. In 1981 relatively more – 5—6 – families were found with 4—5 young.

There are disturbances due to human activity, especially helicopters low overhead frightening breeding birds even off nest.

There are few data as to autumn-summer gatherings and no data for winter, but 200 were seen on 1980. 11. 16.

Kiskun National Park

Data by *Bankovics Attila.*

The most important breeding area here is the Kisrét near Szabadszállás, but there are some in Zabszék, Pipásrét, Kelemenszék near Fülöpszállás lake Kondor at Fülöpháza and lake Kolon at Izsák.

It may breed on lake Péteri in the future.

The breeding population in mentioned localities was between 1978 – 81 as follows:

	1978	1979	1980	1981
Kisrét	30	15	18	15
Zabszék	6	10	10	10
Pipásrét	–	5	5	8
Kelemenszék	–	–	8	4
Kondor lake	2	2	2	2
Kolon lake	10	5	5	5

Among mentioned breeding grounds those nesting on Kisrét inhabit extended reed *(Phragmitetum)*. The waterstand is more stable than in other Kiskun lakes, it dried only in 1979. The overexploiting, cut of the reed-harvest is a problem.

The geese find feeding grounds near the nests in a distance of 200 – 400 ms, partly on islets, partly in the lake's rand zone.

Among the late summer gatherings the one on Kelemenszék is the most important collecting 3 – 400 in August. South of the Park the Pusztaszer lakes are also to mention where 1200 were observed on 1975. 11. 15th and 1000 on December 17th *(Molnár L.)*.

Problems and possibilities in Grey-leg Goose protection

There were well known effects due to changes in past on the distribution of the Grey-leg Goose. The population recovery due to protection and other factors was mentioned also by present study.

In the present situation the further increase of the population is hampered by the mechanised total reed-cut. This same problem in Hortobágy and Kiskun N. P.-s and on lake Fertő require careful solution as the reed-production played since ancient times a role in maintaining certain habitats.

To increase and protect the population there are various possibilities not yet elaborated.

Ecology

1. Maintain, conserve present breeding grounds, regulation of reed-harvest.
2. Conservation of feeding grounds.
3. Reconstruction of abandoned ancient breeding grounds.

It is favourable to concentrate these reconstructions in areas with strong populations.

Ethology

1. Full undisturbance especially at onset of breeding and during incubation.
2. Full undisturbance of feeding and gathering grounds.

Protection practice

In southern Hortobágy N. P. (Kunkápolnás swamps) there are experiments going on since four years to increase the population of the Grey-leg Goose with artificial nest-bases. The base is formed from reed-bounds and situated in reed *(Phragmites)*, thin-leaved reedmace *(Typha angustifolia)* and bulrush *(Bolboschoenetus maritimus)*. The last two habitats are infrequently occupied by the geese, but in reed the occupancy reached 90%. This protection possibility has an especially good effect in intensive reed-management if there are some remaining reed-patches along channels, etc.

During the study we received many valuable data from veterinary *dr. Radó András* and herdsmen knowing the area exceptionally – we are thankful to all of them.

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IX. *ANSER ANSER* IN TUNISIA

M. Smart

Historical position

A. anser has long been a winter visitor in good numbers to Tunisia. Blanchet (whose notes were not published until 1955, though they had been written in the 1940s on observations in the 1920s and 1930s) calls the species "a very regular visitor" and notes that "flocks, sometimes quite large, stay from November to March in the Ichkeul marshes, especially in the northwest part, at the stuary of the Oued Sejenane". Heim de Balsac and Mayaud (1962) echo *Blanchet's* views, adding that *Zedlitz* (1923) had recorded an "exceptional" case of nesting at Lake Fetzara nearby in Algeria.

The author, who lived in Tunisia in the 1960s, took part in goose counts organized at west Palearctic level by IWRB's Goose Research Group, the results of which were published by *Timmerman et al.* (1976). His observations from the 1960s, together with some counts he made during return visits in the 1970s are summarized in University College London (1977), and include peak counts at Ichkeul of 7000 (January 1969), 9250 (January 1974) and 6600 (December 1975).

Ichkeul, in northwest Tunisia, is the only site in Tunisia where *A. anser* occurs regularly in numbers. The species is recorded in smaller numbers further up the Sejenane valley at Sidi Mecherig, and there is another sizeable wintering flock, just across the border in Algeria, in the plain of the Oued el Kebir (especially at Garaet Mekhada) where 5000 were recorded in 1977 and 8000 in 1978 (*Van Dijk and Ledant* in press). Ichkeul and Mekhada are clearly the two major North African sites.

The origin of the Ichkeul birds is well attested by a series of ringing recoveries. Most come from Czechoslovakia (4 adults, 4 young birds); there is one from Lake Neusiedl in Austria (ringed as a gosling), two post-juveniles from Poland, and, rather surprisingly two from as far west as Sweden (a gosling from Uppland and an adult, presumably moulting, from Gotland).

Despite careful searching at Tunisia's many other major wetlands, the author has only ever seen the odd straggler, at very infrequent intervals, at Lake of Tunis, Garaet el Kebira (near Fahs), Sebkhet Sidi Khalifa and Garaet Hadj Kacem. It is possible that these birds had overshot Ichkeul, but since the sites are much further to the south and east it is likely that their departure point from the northern shores of the Mediterranean was Yugoslavia or the Balkans. This seems the more probable as they were in the company of other geese species, rarely recorded at Ichkeul.

The feeding behaviour of *A. anser* at Ichkeul has always been strikingly different from that familiar in most of the winter range (*Cramp et al.*, 1977). Instead of grazing on grassland the birds feed in the shallow waters of the lake often upending like swans or dabbling ducks to reach subnerged vegetation and coming to dry land only to rest. The ecological conditions of the lake and the surrounding winter-flooded marshes have undergone very little change in recent years, and the geese have not been obliged to adapt their traditional feeding habits. In most of the other great North African fresh-water lakes (eg Lake Fetzara) drainage works have produced massive ecological change.

Recent information

Much valuable new detail has been provided by the work, as yet unpublished, of M. Fay, and American botanist and ornithologist, who worked full time for two years from mid-1978 at Ichkeul in connection with the establishment of the National Park. He noted first arrivals of *A. anser* in mid October, numbers rising rapidly to a peak of 12 000 birds in early December (counts of 10 000 on 10 December 1978, 9000 on 20 December 1979), with a normal midwinter figure of 8000 birds. Numbers were decreasing rapidly by mid February and only a few stragglers stayed until mid March. Odd birds, perhaps injured or sick birds occurred even later. They may even stay all summer (the author has seen odd birds in May and August).

Fay's observations on feeding are more detailed than those of any preceding observers. He records that Ichkeul geese split into two main flocks, one on the southern (Joumine), the other on the northern (Sejenane) marshes. In the Joumine marsh, where the *Scirpus maritimus* growth is not extensive, the main diet is *Scirpus maritimus* roots and *Cyperus laevigatus* culms; they also feed on *Potamogeton* and, to a lesser extent, in hay fields. In the Sejenane marshes, the *Scirpus* cover is more extensive; in the early part of the winter *Scirpus maritimus* is the main food; the geese generally feed in the areas where the *Scirpus* is less dense, because in such areas it is easier to get at the roots, and to watch for predators; there is as a result local overgrazing as well as other untouched areas and Fay suggests thinning of *Scirpus* by burning as a management measure. Later in the winter, green food become available and *Eleocharis palustris* stems and *Cyperus* are important foods. Fay supports these observations of feeding behaviour with analysis of about 150 goose droppings.

With the establishment of the National Park, the Forestry Direction of the Tunisian Ministry of Agriculture maintains permanent staff at Ichkeul. They have reported that numbers may have been as high as 15 000 in winter 1980/81, and have suspected breeding (not impossible in the light of Zedlitz's observation in Algeria).

Conservation measures

The Tunisian government has declared Ichkeul a Ramsar and a World Heritage site, and in December 1980 it became, by government decree, one of Tunisia's first national parks. This will ensure conservation of the habitat within the park boundaries. Plans are however well advanced for the construction of dams on feeder rivers (outside the confines of the park); the effect of these dams, needed for Tunisia's social and economic development, will be to reduce inflow of fresh water in winter and thus permit salt water to flow in from the other outlet the sea. Discussions are at present in progress on ways of limiting these effects – by releasing a minimum amount of fresh water from the dams, and by constructing a sluice between lake and sea.

One other effect of the National Park is the end of hunting in the area. In general, shooting pressure on waterfowl in Tunisia is very low, with only a few hundred waterfowl hunters in the whole country. Naturally enough, however, in a large wetland as rich in waterfowl as Ichkeul, there was a local goose-hunting tradition. Though the number of geese shot was not large, the disturbance caused by hunters way well in the past have prevented the geese from feeding adequately. With permanent staff now on the spot, the ban is being strictly enforced.

Future points of interest

A number of points merit further study:

(i) How many geese are there? A long run of exact counts would be of great interest, to indicate whether the apparent increase is real, and also whether the birds wintering in Algeria transit through Ichkeul. Do 25 000 *A. anser* winter in North Africa, and, if so, where do they all come from?

(ii) How do they get to North Africa? There are no observations of major staging points for large goose flocks between central Europe and North Africa. Do the birds fly direct without stopping, and is the creation of new reserves in Italy likely to tempt them to linger?

(iii) What will be the effect of the shooting ban and its strict enforcement? If the geese increase and stay out of the park, then it may be easier to satisfy the goose hunting tradition.

Other geese in Tunisia — a footnote

Since *Thomsen* and *Jacobsen* (1979) seem unclear on this point, this may be an appropriate opportunity for the author to place his observations on record. All other species are in any case most unusual.

– *Anser albifrons:* 3, Garaet el Kebira (60 kms south of Tunis) on 10 January 1974, in company with 1 *A. anser*. 1 Garaet Hadj Kacem (west of Sfax) on 28 January 1975, in company with 2 *A. anser* (and 1 *Plectrophenax nivalis!!*).

– *Anser fabalis:* 1, Garaet el Kebira on 5 January 1977. *Blanchet* commented that *A. fabalis* might occur accidentally in Tunisia, though he knew of no authentic observation. R. Thorpe (pers. com.) reported a small flock with *A. anser* at Ichkeul.

– *Branta bernicla:* 1 immature, of the race *Branta bernicla bernicla* at Lake Kelbia on 11 December 1975, grazing on winter grain with *Anas penelope*. Also observed by *Dr. L. Hoffmann* and personnel of the Tunisian Forestry Direction. In the light of this extraordinary observation, Loche's 1867 remark that the species is rare and accidental in Algeria seems more credible.

While the *A. albifrons* and *A. fabalis* presumably reached these more southerly Tunisian sites by overshooting from the general area of Yugoslavia, one can only speculate on the origin of the *B. bernicla*. Ex Africa semper aliquid novi!

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X. ANSER ERYTHROPUS IN FENNOSCANDIA

A. & M. Norderhaug

Introduction

Anser erythropus was originally a common species in northern Fennoscandian mountain regions. Since the 1950s, however, its numbers and distribution have declined drastically. Today, the species is extremely rare, and its distribution is restricted to only the more remote parts of its former breeding area.

Little information has been available on its present population size, status, population trends and the negative factors responsible for its decline. A project was organized in 1975 for this purpose, to compile available data from Finland, Norway and Sweden more systematically. The present paper summarizes the result of this study. The summary is partly based on published data, partly on information from a number of ornithologists in these three countries. In addition, restricted field work has been carried out from 1977 to 1980. The present paper is based on three status reports (*A. & M. Norderhaug* 1976, 1977 and 1980) and a final summary paper for the report of the Nordic Goose Project under the Nordic Council for Game Research (*A. & M. Norderhaug* in prep.).

Past and present distribution in Fennoscandia

Distribution of the *A. erythropus* in Fennoscandia has previously been described by various authors. More or less complete distribution maps have been published by *Ekman* (1922), *Dahlbeck* (1946), *Rosenberg* (1953), *Curry-Lindahl* (1957, 1959) and *Haftorn* (1971).

The past distribution of the species in Fennoscandia has been summarized in Figure 1, based on these distribution maps and various more detailed information in the literature on the occurrence of *A. erythropus* during summer. In practice, this refers to published information on the breeding distribution up to 1960, with some additions from recent years.

The original breeding area was probably somewhat wider, since published data during the first part of this century were most likely not in complete accordance with the actual breeding distribution.

In Figure 1 the present distribution is also summarized based on more detailed maps given an *A. & M. Norderhaug* (1980). The present distribution area is defined as the area where *A. erythropus* has bred or been observed during the breeding period between 1960 and 1980. For this period the distribution area is presumed to be more complete. However, between 1960 and 1980 a further decline in the population and breeding distribution has most certainly taken place. One surprising aspect of the present distribution (1960 – 1980) is the apparent size of this area compared to the former breeding range. It must however be kept in mind that coverage in recent years was more complete, compared to the first part of this century. A second factor is also important:

within the area where *A. erythropus* has been observed for the last 20 years, the population density has been severely reduced compared to the original situation. However, in general it can be concluded that scattered pairs still breed within 40 – 50% of the former Fennoscandian breeding range.

Population size and population changes

Reliable data on the size of the Fennoscandian population of *Anser erythropus* have never been published. Evidence of serious population changes has primarily been based on the following:

1. The observed reduction in the size of the actual breeding area (= 40 – 50%).

2. Decline in numbers of migrating greese observed at traditional resting places, mainly on the Finnish west coast (see Figure 2). The number of migrating *A. erythropus* along the Finnish west coast was described by *Merikallio* (1915) (translated from Swedish) before the serious decline was evident:

"The number of migrating birds must at least be counted in tens of thousands.

As an example need only be mentioned the 17 May 1913 at Karlo (in spring 1913 I observed their migration rather carefully) when one flock after another passed northwards during the whole day. Many times during that day, one flock had not disappeared before another came from south".

3. Information from the wintering grounds. In the 1930s, 30 000 to 50 000 may have wintered in the southeast parts of the Caspian Sea (*Bauer* & *Glutz von Blotzheim*, 1968). By the mid 1970s the population in this area was probably reduced to about one tenth of the former level (*D. A. Scott*, pres. comm.).

Specific data from the Fennoscandian breeding area are few. According to Finnish ornithologists (*Siivonen*, 1949, *Merikallio*, 1955 *and T. Lampio* in litt. 1976) the Finnish population in the 1920s and 1930s may have been of the order of 1000 to 2000 birds. The total Fennoscandian population at that time may well have been of the order of 10 000 birds. As early as this, however, the population may have started to decline. Accordingly, the total Fennoscandian population may well have been of the order of over 10 000 before the decline.

Figures indicating the size of the present population in Fennoscandia are also lacking. The maximum number observed at one time in various months in recent years may however be of interest. In Table 1. the recorded maximum size of flocks observed in Fennoscandia 1960 – 1980 are summarized from various sources.

1. During 1960 – 1980 *A. erythropus* bred, or was observed during the breeding period, in 43 equal (square) geographical units in Finland, Norway and Sweden. It was presumed that in 1980 birds were still breeding within 30 of these geographical units.

Table X/1.

Maximum size of flocks of Anser erythropus recorded in Fennoscandia, 1960 – 1980

Month	Maximum observed in one flock	Country	Location	Year
April	16	Sweden	S. Vasterbotten	1966
May	cca 100	Finland	Lumijoki	1977
June	8	Sweden	Padjelanta	1966
July	30 – 50	Norway	Nordland	1970
August	20	Finland	Aland	1960

2. Allowing for an average of two to three breeding pairs within each of these units, there is a total of 60 to 90 pairs (120 to 180 breeding birds) within the region.

3. In addition, the population includes a proportion of one/two-year old non-breeders, estimated at 30 – 40% of the breeding population. This assumption gives an additional 40 – 80 birds.

Based on these assumptions, the order of size of the present Fennoscandian population was estimated at 160 – 260 birds, or in more general terms, of an order of less than 500 birds.

Further data from the three countries should, if possible, be compiled in the 1980s to refine this estimate.

Productivity

Few data are available from Fennoscandia on the productivity of *A. erythropus* from the first part of this century, when the species still was numerous, as data on productivity were rarely collected. From recent years, the number of observed clutches have for obvious reasons been very restricted.

Comparison of data from recent years with data from the first part of this century reveals no apparent differences, indicating that the productivity of breeding pairs has probably not changed. The average clutch size (n = 14) was 4.9, range 3 – 6. The average brood size (n = 23) was 4.1, range 1 – 6. The number of breeding records from recent years (1960 – 1980) is very restricted (see Table 2). The majority of these records are from Norway and Sweden. In Finland the species is now clearly on the brink of extinction (see Table 3).

As early as the beginning of this century, the migratory pattern of this species was extensively studied and discussed among Finnish ornithologists notably *Munsterhjelm* (1911, 1915) *and Merikallio* (1915, 1920). *Hortling* (1929) summarized the migratory pattern in Fennoscandia:

Anser erythropus arrives on the south coast of Finland from a southerly direction, crossing the Gulf of Finland. From there the main part of the population migrates northwards along the Finnish west coast, and smaller numbers

Table X/2.

Number of breeding records of Anser erythropus in Fennoscandia, 1960 – 80

Period	Total	Range	Average per year
1960 – 1964	11	1 – 4	2.2
1965 – 1969	5	0 – 2	1.0
1970 – 1974	10	0 – 5	2.0
1975 – 1979	9	0 – 4	1.8
1980	1		

Table X/3.

Breeding records of Anser erythropus in Finland, Norway and Sweden, 1960 – 1980

Period	Finland	Norway	Sweden	Total
1960 – 1969	1	5	10	16
1970 – 1980	1	12	7	20
Total				
1960 – 1980	2	17	17	36

Migration

migrate on a broader front across inland areas of Finland, and others north-east towards the White Sea.

Earlier, as well as more recent observations confirm the migration of *A. erythropus* along the Finnish west coast. Undoubtedly this is the main migration route (spring and autumn) for the Fennoscandian population. However, as pointed out by *Hortling* (1929), this does not preclude others migrating along a more easterly route to breeding areas located in northern Norway and western parts of the USSR. This eastern migratory route may still be used, according to the following observations:

– *A. erythropus* observed on migration eastwards, close to Helsinki in spring 1974 (K. Malmstroem pers. comm.).

– Regular spring observation of *A. erythropus* towards the inner parts of the Varangerfjord, northern Norway (R. Carlsen pers. comm.).

An outline of the migratory pattern of *A. erythropus* in Fennoscandia appears from Figure 1.

Spring migration in Fennoscandia can be described as follows:

– They arrive in spring relatively late, and depart early in the autumn.

– During spring, flocks are relatively small; this was also the case in earlier periods, according to *Merikallio* (1920).

– The first birds may arrive on the west coast of Finland in the latter half of April, but arrival in early May is more common. Along the Finnish coast the

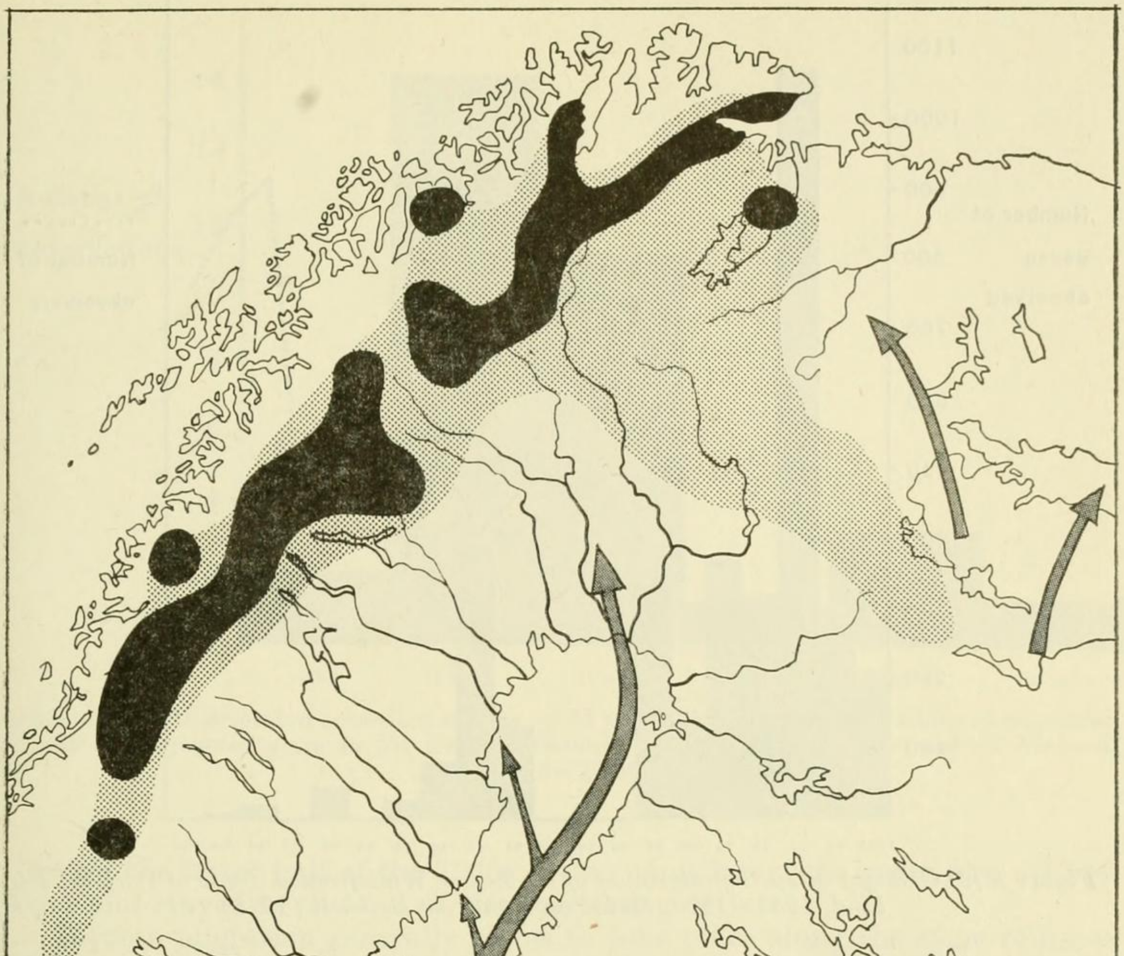

Figure X/1: Past and present (1960 – 80) distribution of Anser erythropus in Fennoscandia. Arrows indicates migratory routes

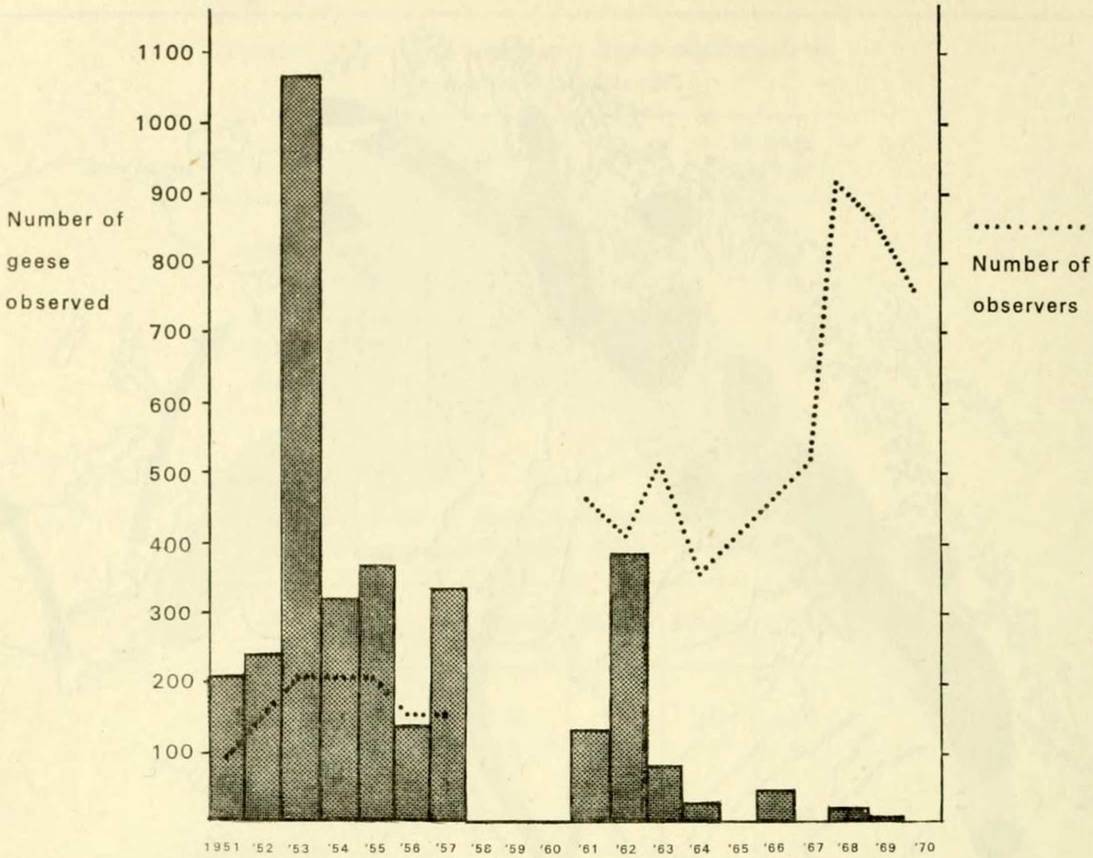

Figure X/2: Changes in spring migration of the Lesser Whitefronted Goose at Pori W. Finland, 1951 – 1970. Based on data from Soikkeli (1973)

maximum is reached in mid-May, and migration continues until the end of the month.

– During the first half of May the population migrates northwards in the Gulf of Bothnia. At this time birds may be observed on both the Finnish and the Swedish side.

– From mid-May and towards the end of May/beginning of June, the geese arrive on their breeding grounds.

The direct flight speed during migration has been measured in Finland, May 1959 (*Bäck*, 1959). Over a distance of 35 Kms, the speed of a flock of 29 *A. erythropus* was measured at 80 – 85 km/hr. Spring migration from coastal regions depends to a high degree on snow cover and the overall spring situation. At one stop overpoint in Finnmark (northern Norway) the final stage of spring migration can still be studied (20 – 50 geese) before the geese disappear to their breeding areas. Data on the migratory pattern have been collected at this locality in the period 1971 – 1980. In general the geese gather there during May, feeding until snow cover allows the establishment of breeding territories inland. Arrival and departure vary greatly from one year to another, depending on the snow cover and spring situation.

During the first part of the 1970s spring came early. In this period the geese arrived early and dispersed to breeding areas in the third week of May.

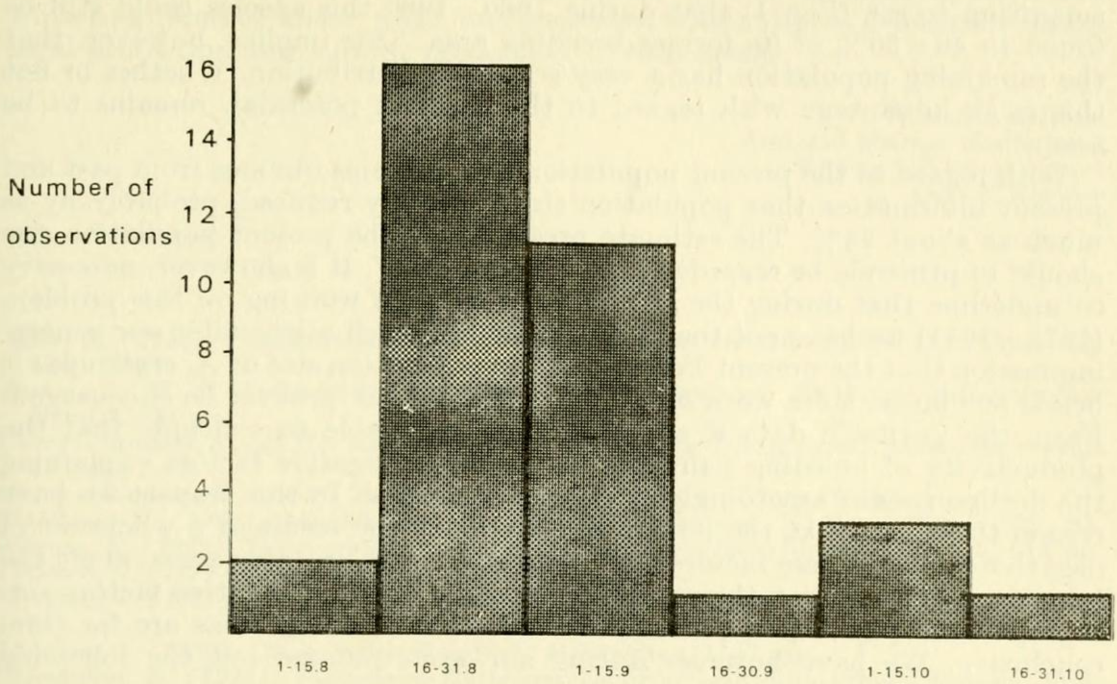

Figure X/3: Distribution according to time, of 34 published autumn observations of migrating Lesser Whitefronted geese in the Gulf of Bothnia and on the southern coast of Finland, 1905–1974

During the latter half of the 1970s spring came later; the geese also arrived later and stayed to the end of May/beginning of June.

Autumn migration generally seems to take place along the same route as the spring migration. According to *Merikallio* (1920) autumn migration on the Finnish west coast started about 26 August and ended about 12 September. During autumn migration along the Finnish west coast, the earliest birds recorded (according to various sources from the period 1912–1949) were on 10 August (*Karlo*, 1912). More regularly, the first birds appeared about 20–22 August (see Figure 3).

Discussion

Studies of endangered species like *A. erythropus* cause a number of problems for obvious reasons:

– The possibility of systematic field work is very restricted.

– More detailed data on questions such as biology and population size from periods when the species was still numerous, are very restricted.

– More recent information has often been available only from scattered notes or through personal contacts.

The present description of the status of *A. erythropus* should primarily be regarded as an effort to utilize available data more systematically, and to draw some conclusions from these data.

In relation to the present restricted size of the population, it is somewhat surprising to see (Fig. 1) that during 1960 – 1980 this species could still be found in 40 – 50% of its former breeding area. This implies, however, that the remaining population has a very scattered distribution. Whether or not this is an advantage with regard to the survival potential, remains to be seen.

With regard to the present population size, it seems obvious from past and present information that population size is heavily reduced, probably by as much as about 95%. The estimate presented on the present population size should in principle be regarded as a "guesstimate". It is, however, necessary to underline that during the period we have been working on this problem (1975 – 1981) we have not found any evidence which might alter our general impression that the present Fennoscandian population size of *A. erythropus* is below 500 birds. More work on this question should however be encouraged. From the available data it seems further reasonable to conclude that the productivity of breeding pairs has not delined. Negative factors explaining the decline should accordingly be sought elsewhere. In this respect we have reason to believe that the population decline is the result of a whole set of negative factors. These factors may be sought in the breeding areas, along the migratory route and on the wintering grounds. Data on negative factors acting upon the population in the Fennoscandian breeding areas are far from conclusive. We have however during our work pointed out the following potential negative factors:

– Illegal hunting (in earlier period).

– Disturbance in the breeding areas.

– Disturbance at the moulting grounds.

– Disturbance on resting sites used during migration (both within Fennoscandia and elsewhere).

– Damage to biotopes (hydro-electric power projects?).

– Expansion of the red fox into mountain regions (I. Ahlen pers. comm.).

In general, however, we believe that the main causes for the decline must be sought along the migratory route and in the wintering quarters. With regard to migration, the migratory pattern seems to be fairly clear, mainly because of studies conducted in Finland in the first part of this century. It seems reasonable to conclude that the best way to monitor further population changes in the small population still left would be to study carefully annual variations in numbers at the few migratory sites still in use in Fennoscandia.

At the beginning of the 1980s the future of the remaining population of *A. erythropus* in Fennoscandia is very uncertain. It must be regarded as a conservation task of high priority in Finland, Norway and Sweden to continue studies on this species and to develop a joint conservation programme. In this connection, the most important elements would be:

– Further studies of existing breeding, moulting and migration areas in use.

– Establishment of a co-ordinated observation system in the three countries to monitor the population.

– Better protection of migration, breeding and moulting sites still in use.

– Increased public information, aiming at better understanding and conservation of this species.

– Further development of the present Swedish captive breeding programme.

– Further studies on the situation of the species during migration and wintering (studies under way), and increased international efforts for better legal protection and habitat protection of vital areas.

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XI. AN EFFORT TO REINTRODUCE THE LESSER WHITE-FRONTED GOOSE (ANSER ERYTHROPUS) INTO THE SCANDINAVIAN MOUNTAINS

L. von Essen

Introduction

The strong decline of the Lesser White-fronted Goose *(Anser erythropus)* in the breeding area in Fennoscandia during the past decades has been described by *A. and M. Norderhaug* in their work "Dverggasa *(Anser erythropus)* in Fennoscandia", 1980. The present very exposed status of this species within Sweden is emphasized in PM 1295 "Fauna areas in the mountain region" 1981 by the National Swedish Environment Protection Board. My own investigations and inquiries in a couple of areas where the Lesser White fronts has been common also proved that it is now almost gone.

The reason for the disappearance of the *Anser erythropus* has not yet been established. Since 1966 it is quite protected by law. A previous illegal hunting on the moulting areas and increased disturbance within certain breeding areas might be contributing reasons for the decrease. We do not know the circumstances on the wintering areas. There are only two refindings of *Anser erythropus* banded in Sweden. One is from the northern part of Greece, the other is from Divnoje, South of Russia (between the Black Sea and the Caspian Sea).

In spite of the fact that the reasons for the disappearance of the *Anser erythropus* have not yet been made clear the Swedish Sportsmen's Association decided in 1976 to start a breeding of geese for reintroduction and thus try to build up a new stock. At the same time we should go on working on the Lesser White-fronted Goose and the circumstances that might have an effect on the stock. The Association has received economic support from WWF for this activity. The first reintroduction experiment took place in Lapland in July, 1981.

Rebuilding of the breeding stock

During 1977 – 1979 young *Anser erythropus* have been acquired from Water-Fowl Breeding Farms in Holland, England and West Germany. At present there are about 70 breeding fowls on four different places in Sweden, most of them at the Swedish Sportsmen's Association's Institute for Wildlife management at Öster-Malma, 90 km Southwest of Stockholm. Methods for the reintroduction.

On establishing a method for the reintroduction, the method used by professor Eric Fabricius at the reintroduction of Greylag geese *(Anser anser)* and also used by the Swedish Sportsmen's Association at the reintroduction of Bean Geese *(Anser fabalis)* on earlier well-known breeding areas in the middle of Sweden, has been of guidance. In order to give a natural growth, care and migration tradition to the released goslings the Canada Goose *(Branta canadensis)* have been used as foster-parents to both species. In short, normal proceeding is that the eggs of Canada Geese, which are breeding wild, are exchanged for eggs from Bean Geese produced at Öster-Malma. When the hatched Bean Goslings are half grown and the Canada Goose parents are moulting, the brood is caught and transported to the reintroduction areas where it is released. The goslings are imprinted in this area where they start to fly for the first time. In the autumn the brood moves to areas surrounding the south of the Baltic for wintering. The brood comes back to Öster-Malma by the beginning of April. The Canada Geese start a new breeding and drive away the young Bean Geese from last year. After a couple of days they disappear from Öster-Malma and eventually they can be seen in the area where they were released last year. These areas are about 350 km north-west of Öster-Malma.

Since 1974 about 100 *Anser fabalis* goslings have been released most of them in accordance with this method. In the summer 1978 the first breeding of these *Anser fabalis* could be proved in the reintroduction area. The fowls have been identified with the help of colour rings on their legs.

As to the *Anser erythropus* the *Branta canadensis* is considered to be too big for the little *Anser erythropus*. Furthermore, it is most likely that the *Branta canadensis* do not move south far enough for them to manage during the winter.

Still, at Skansen, the zoological park in Stockholm there is a population of about 100 Barnacle Geese *(Branta leucopsis)* which since ten years during the winter move to Holland. This has been proved thanks to reports about nine recoveries as well as observations of banded geese. During the spring they have been seen passing Schleswig-Holstein in the north of West Germany. In spite of the fact that the natural migration route of the *Anser erythropus* from Scandinavia goes in a southeast direction we have decided to try the *Branta leucopsis* as foster-parents.

The first reintroduction experiment

During the spring 1981 three egg clutches from *Anser erythropus* have been layed under breeding *Branta leucopsis* at Skansen. In consequence of distrurbances and predation only one pair managed two goslings. The brood was caught and moved to Öster-Malma when the goslings were three weeks old. Another eight *Anser erythropus* goslings which have been brought up under pinioned *Anser erythropus*, were put together with them in a cage. Four goslings were placed together with another pair of *Branta leucopsis* and their two own goslings. After a fortnight the *Branta leucopsis* parents had adopted the *Anser erythropus* goslings quite well and on 15 July, when the goslings were about five weeks old, both broods were transported to the south of Lapland, where they were released on a mountain lake area.

The group released thus consisted of one pair of *Branta leucopsis* with two foster-goslings and eight adopted nestlings. The latter pair's own goslings had been taken away. So together there were four *Branta leucopsis* and 14 *Anser erythropus* goslings.

Three days after the releasing the group was observed and well gathered. The birds were also very shy in their behaviour. The number of *Anser erythropus* goslings were at that time only ten. The decrease can be explained by the fact that, during the long transportations, two goslings got hurt and one was found dead the day after the planting out. What has happened to the birds later in the summer and autumn is not known. On some occasion they have been observed by a Lapp.

With the economic support from World Wildlife Fund, the Swedish Sportsmen's Association intent to go on with the reintroduction efforts for some years to come. In this connection I want to draw the attention of bird watchers in Scandinavia and in the middle of Europe to the fact that during winters ahead, goose families consisting of *Branta canadensis* with young *Anser fabalis* and also *Branta leucopsis* with young *Anser erythropus* may turn up.

All these geese released are banded with a numbered ring of aluminium and three colour rings in a special combination for each bird. Each colour represents a figure from 0 to 9. Should any of these birds or groups of birds be observed, I, as leader of the project, would be very grateful for a report even if the colour combinations have not been observed.

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XII. MIGRATION OF *ANSER ERYTHROPUS* AND *BRANTA RUFICOLLIS* IN HUNGARY 1971–1980

I. Sterbetz

Introduction

Because of its zoogeographical conditions, Hungary figures among the most important goose stations in central Europe. Early this century, northern Anser species still passed through in vast numbers. The largest traditional gathering place for *Anser erythropus* on our continent has evolved here. From the 1950s onwards, however, migrations have lost in dynamism. Regression is the most remarkable, being of almost catastrophic extent, in *A. erythropus.*

When evaluating the critical situation of *Anser erythropus*, the rate of decrease should be stated first. Information must be gathered about the breeding population from which the passing birds originate and the place where they spend the winter. Finally, for ecological evaluation it should be established whether the environmental changes at goose gathering places in Hungary can be connected with the evolving regression.

Branta ruficollis was a sporadic phenomenon in the one-time goose masses; in recent years, it has become somewhat more frequent. The question is whether the movement in Hungary that is becoming rather dynamic is a new phenomenon or a natural fluctuation manifesting itself within a longer period.

Material and methods

Since the two goose species at issue represent an important problem in international waterfowl preservation, it is desirable to study in detail all data from the last ten years. For comparison of former and present-day dynamism of migration, the data on former status are derived from the studies enumerated in the references and some additional works of reference cited there in though not repeated here due to their size. For present status the author has used the statistics on Hungary compiled by the IWRB, completed with publications by *Dr. Cs. Aradi, Dr. G. Kovács and I. Farkas;* his own observations were carried out in the first place on the Kardoskút, at Nagyszénás, Csabacsüd, Biharugra and in the Hortobágy.

Findings

Anser erythropus

Migration of *A. erythropus* follows a narrow route east of the River Tisza. In between the Danube and the Tisza this species is but a rarity and west of the Danube it has not been observed so far (*Sterbetz,* 1968). At the most significant gathering places of *A. erythropus* (the Hortobágy, Biharugra, Kardoskút, Nagyszénás and Csabacsüd) in the years preceding the 1950s the late autumn peak of the northern Anser species numbered altogether some 800 000 birds (literature on the subject in *Sterbetz*, 1967, 1972 as well as author's own investigations). The Hortobágy was the most significant station where, according to hunting statistics, 12 000 to 14 000 geese were shot annually in the period from 1934 to 1938. The bag consisted of about 80% *Anser albifrons*, with 6 to 8% *A. erythropus*. Earlier shooting lists showed a similar tendency, with only small deviations (*Szomjas G.*, 1928, *Szomjas L.*, 1926, *Graefel*, 1934). This division, however, does not offer a true picture since by autumn, before the hunting in the Hortobágy, the first waves of *A. erythropus* migration have already passed through. Findings by *Tarján* (1926, 1931) and *Nagy* (1938) based on continuous observations seem more probable; they put the share of *A. erythropus* in the goose masses of the Hortobágy at about 10 to 15% in general. My own counts, carried out between 1947 and 1951 at Nagyszénás, Biharugra and in the Hortobágy yielded similar results. This diagnosis is valid for other goose gathering-places with the character of the Hortobágy, in eastern Hungary. On this basis, about 80 000 to 120 000 *A. erythropus* could be reckoned with in Hungary in the decades before the regression. This enormous concentration disappeared almost overnight in the 1950s. At the beginning of counts for the IWRB in 1967, they numbered about 5000, then decreased slowly to the present status as shown in detail below.

Hortobágy 47° 37′ N 21° 05′ E

1971: 19 Mar. a few, 2 Apr. 3, 14 Oct. 25;
1972: 26 Feb. a few, 27 Feb. 40, 1 Mar. 150, 5 Mar. 300 – 500, 10 Mar. 150 – 200, 12 Mar. 40, 16 Mar. 7, 21 Mar. 20, 14 Oct. 20;
1973: 14 Oct. 380;
1974: 16 Mar. 60, 15 Nov. 200;
1975: 15 Oct. 30, 17 Nov. 200 – 250;
1976: no observation all year;
1977: 21 Mar. 100 – 150, 23 Mar. 20 – 25, 16 Oct. 39, 13 Nov. 146;
1978: 12 Mar. 150, 15 Oct. 150, 19 Nov. 115, 17 Dec. 300;
1979: 11 Feb. 40, 15 Mar. 100, 15 Oct. 320, 15 Dec. 200;
1980: 17 Feb. 8, 16 Mar. 8, 9 Sep. 3500 – 4000, 12 Sep. 300, 19 Sep. only a few, 12 Oct. 18, 16 Nov. 36;

Biharugra 46° 58′ N 29° 36′ E

1971 – 1976: ?
1977: 16 Oct. 36;
1978: 15 Oct. 11, 17 Dec. 1100;
1979: 11 Feb. 16, 15 Dec. 120;
1980: 17 Feb. 1, 16 Mar. 2, 12 Oct. 19, 16 Oct. 19, 16 Nov. 36;

Kardoskút – Békéssámson 46° 30′ N 20° 28′ E

1971: 14 Feb. 5, 16 Oct. 30, 21 Oct. 150, 1 Nov. 20, 13 Nov. 2000, 12 Dec. 15;
1972: 14 Jan. 30, 13 Feb. 1000, 12 Mar. 40, 28 Oct. 500, 11 Nov. 300, 15 – 17 Dec. 5000 each day;
1973: 17 Mar. 2000, 1 Nov. 1000;
1974: 17 Feb. 80, 26 – 27 – 28 Feb. daily 5000, 2 Nov. 1000, 18 Dec. 2000;
1975: 14 Aug. 1, 25 Nov. 100, 4 Dec. 500, 17 Dec. 15;

1976: 16 Oct. 300;
1977: 16 Oct. 312, 13 Nov. 150;
1978: 12 Mar. 150, 15 Oct. 200, 29 Oct. 12, 19 Nov. 70, 17 Dec. 1250;
1979: 11 Feb. 25, 15 Mar. 200, 15 Oct. 7, 15 Dec. 1300;
1980: 17 Feb. 11, 16 Mar. 10, 12 Oct. 11, 16 Nov. 22;

Szabadkígyós 46° 36′ N 21° 06′ E

1978: 12 Mar. 200

Tótkomlós – Pitvaros 46° 25′ N 20° 44′ E

1972: 15 Jan. 70

Szegedi-Fehértó 46° 15′ N 20° 10′ E

1979: 15 Dec. 11

To summarize the data of ten years: in January there has been an aggregate of 30 (2 observations), in February 6226 (14 observations), in March 4067 (20 observations), in April 3 (1 observation), in August 1 (1 observation), in September 4300 (3 observations), in October 2721 (22 observations), in November 7041 (14 observations), and in December 11 811 (14 observations).

In the period from 1971 to 1980 the average number observed yearly was only 3620, i.e. a decrease of 95 to 97% as compared to the masses before the regression! At present, *A. erythropus* only represents 1 to 2% of the total of *Anser species* passing through the Hortobágy, Biharugra and Kardoskút in invasion years. Otherwise it remains below 1%, behind *Anser albifrons* which is dominant with 90% and *Anser fabalis* and *Anser anser* sharing the remaining part. Even if concrete figures from the past are disregarded, because of possibilities of error in calculation, it is beyond question that 30 to 40 years ago, *A. erythropus* passed trough eastern Hungary in masses that could be expressed in tens of thousands, whereas nowadays only an insignificant fraction of this figure is recorded.

It seems open to objection that under these conditions the bird can be hunted. This possibility, however, is of no practical significance from the aspect of conservation. The goose bag in Hungary has been about 4000 to 6000 in recent years, and merely one or two *A. erythropus* are met sporadically in the bag. In dawn and twilight hunting this species is hard to recognize in the mixed goose flocks, especially if not observed by a practised ornithologist. Therefore, no better protection would be provided for it by game laws.

From time to time "invasion" periods are noticed in the migration of *A. erythropus* in Hungary, indicating the existing state of the population. Such invasions occurred in 1898, 1907, 1911, 1916, 1920, 1922, 1930, 1935, 1945, 1949, 1969, 1972, 1974 and 1980 (*Sterbetz*, 1968). The autumn migration divides into two clearly separable phases. The first wave arrives late in September or early in October and should the food conditions be unfavourable, quickly passes on. The second wave arrives in November and these flocks hold on until snowfall. The origin and final destination of the route through Hungary have not been determined by ringing data.

To study their ecological requirements, the author analysed the stomach contents of 100 *A. erythropus* (*Sterbetz*, 1978a). In every one of the specimens examined, juvenile vegetative residues of the natural steppe vegetation of a *Festuca pseudovina* association were dominating. Part of the insignificant quantity of seed food presumably got into the digestive system secondarily through grazing. Simultaneously with these studies of *A. erythropus*, stomach contents of 175 *Anser fabalis* and 260 *Anser albifrons* were also examined. In these two species, since the time maize has been harvested in Hungary with heavy duty machinery, maize residues left over on the stubble fields dominate in a remarkable way in the autumn and winter food of both *A. albifrons* and *A. fabalis*. These geese stray for months within a radius of 50 to 70 km and feed exclusively on maize seeds (*Sterbetz*, 1979). *A. erythropus*, on the other hand, does not exploit this food boom, but in a conservative way persists in the natural *Festuca* lowland plain environment. Accordingly, its scope of movement is small, barely 5 to 6 km. In rainy autumn periods, when young grass is available in abundance, it remains for a long while. But in drought conditions, it quickly moves on. In spring, feeding conditions are always favourable, but for hormonal reasons the pace of migration is fast at that time. The author has evaluated the choice of feeding sites on the basis of 177 observations. In 67% of the cases, the birds were in an environment of natural *Graminea* vegetation, in 17% on fields of young grain and in a further 16% of cases, the birds stayed on water. In addition to the special food requirements, another ecological requirement is a lowland plain of the steppe type.

In Hungary, *A. erythropus* chooses feeding and roosting places only on extensive open grassy lowland plains, on natron lakes and on lowland fishpond system units larger than 200 to 300 ha. It does not stay on reedy deepwater lakes nor on shallows, on stagnant or forest lakes.

Branta ruficollis

B. ruficollis was presumably first observed in Europe during the creative years in the Hague and Amsterdam of the Flemish painter *M. Hondecoeter* who in his paintings entitled "Lutte de paon et coq" (Museum of Fine Arts, Budapest) and "La plume flottante" (Rijks-museum, Amsterdam) depicted this bird (*Sterbetz*, 1978b). The first specimen verified by collection was found in the vicinity of London in 1766 (*Withery et al., 1948*). From this date on, *B. ruficollis* is present from time to time sporadically at the gathering places of European wild geese. In Hungary, the first record dates from 1916 and since that time a total of 948 specimens were noted in 137 occasions. These observations are discussed in comprehensive as well as complementary reports published from time to time by *Vasvári* (1929), *Sterbetz* (1962, 1967a), *Sterbetz and Szijj* (1968), *Schmidt* (1973), *Sterbetz* (1975a, 1976a, 1976b), *Benei et al.* (1978), *Schmidt* (1979) and *Sterbetz* (1981). Detailed data (some already published) from the period between 1971 to 1980 are given below.

Hortobágy 47° 37′ N 21° 05′ E

1972: 5 Mar. 1, 10 Mar. 4;
1976: 25 Nov. 2;

Kardoskút 46° 30′ N 20° 28′ E

1972: 16 Dec. 1;
1974: 28 Feb. 27, 23 Nov. 1, 15 Nov. 10;
1978: 15 Jan. 5, 15 Oct. 11, 29 Oct. 11, 6 Nov. 2, 7 – 8 Nov. 15, 19 Nov. 15, 17 Dec. 41;

1979: 15 Mar. 14, 6 Nov. 16;
1980: 18 Oct. 2, 25 Oct. 6, 15 Nov. 52;

Szegedi-Fehértó 46° 15′ N 20° 10′ E

1973: 7 Nov. 11, 10 Nov. 1, 28 Nov. 2;
1977: 23 Nov. 1;
1978: 15 Jan. 5

Fülöpszállás 46° 59′ N 19° 15′ E

1972: 1

Szabadszállás 46° 52′ N 19° 14′ E

1976: 18 Nov. 1

Pellérd 45° 40′ N 16° 06′ E

1974: 17 Mar. 3;

Darvas 47° 20′ N 20° 51′ E

1978: 19 Nov. 7.

Since all observations of *B. ruficollis* in Hungary are supported with data, the pace of its migration can be evaluated over all 65 years.

Distribution of the data: in January 92 (8 observations), in February 106 (9 observations), in March 137 (27 observations), in April 83 (3 observations), in "spring" 3 (1 observation), in October 135 (22 observations), in November 337 (54 observations), in December 103 (10 observations) and in "autumn" 15 (3 observations).

Comparison of the dynamics of migration in the periods from 1916 to 1970 and from 1971 to 1980 clearly indicates that 20% of the observations and 30% of the numbers observed are derived from the last ten years.

When interpreting the species' occurrences in Hungary, it is certainly the ecological conditions that are the most striking. Some 89% of the observations and 93% of the numbers observed are derived from the extensive natural *Festuca* lowland plains, also characteristic of *A. erythropus*. The author has personally observed *B. ruficollis* on 28 occasions, 16 times in natural *Graminea* communities, in five instances on fields of young grain and in seven cases on natron lakes in lowland plains. Results of stomach content investigations of 9 specimens from Hungary and 1 specimen from the Danube Delta in Roumania give: *Graminea* sp. leaves on 3 occasions (traces); *Festuca pseudovina* leaves on 2 occasions (traces); *Triticum vulgare* leaf on 3 occasions (traces); *Bolboschoenus maritimus* seeds on 2 occasions 198; *Setaria glauca* seeds and ground up remains of such seeds on 1 occasion (traces); *Triticum vulgare* seeds on 1 occasion 81; gravel and Sand on 6 occasions (traces) (*Sterbetz*, 1975a).

Conclusions

Anser erythropus

In the last 25 years, the average numbers of *A. erythropus* passing through Hungary have diminished to 3 to 5% of the quantity which formerly passed through regularly. This collapse-like regression points to a catastrophe since the phenomenon is general and the masses of *Anser erythropus* missing in Hungary have not been found elsewhere.

On the basis of the geographical situation, the northwest to southeast tendency of migration in *A. erythropus* in Europe, and the recovery of a bird ringed in summer in Swedish Lapland and found in winter in Greek Macedonia (*Höglund* in *Bauer and Glutz*, 1968), it is presumably the Fenno-Scandinavian population that occurs on the gathering places in Hungary. The present-day Norwegian – Swedish – Finnish stock, however, is smaller in number than the average quantity observed in Hungary (*Soikkeli*, 1973, *Norderhaug*, 1981). Thus, there is no doubt that migratory birds also arrive from the USSR. Some old publications from the Balkans considered standard works and recent information in *Timmerman et al.* (1976) render it probable that geese taking the Hungarian migration route divide to go to wintering sites in Albania, Yugoslavia, Greek Macedonia, Roumania and Bulgaria.

Stomach content examinations and statistics of field observations point to the special steppe biotope requirements of *Anser erythropus* and its conservative adherence to such areas. It follows that the conditions of extensive grassy lowland plains are primary causes in the choice of pace of migration, traditional routes and gathering places.

Undoubtedly, such ecological conditions are not now available for wild geese as they were in earlier decades in Hungary. Grazing on natural salt deserts has declined in intensity and in addition to creation of nature conservation areas, meadows and pasture are being fertilized. These factors promote development of such tall rich phytocenoses that wild geese are unable to graze. The extent of the steppe environment has also diminished. These changes, however, have not yet developed to such an extent as to be considered important in interpreting the regression. In spite of the negative phenomena outlined above, Hungary still disposes of sufficient biotope for *A. erythropus* to satisfy the requirements of a considerable part of the quantities observed in the past. Therefore, assumption that regression is caused by changes in migrating traditions must be ruled out. It seems much more probable that the collapse of the numbers of this species should be ascribed to problems in the breeding sites.

Branta ruficollis

Review of the 65 year-old past of movements in Hungary indicates that *Branta ruficollis* is to be found in small numbers, but appears relatively regularly in the lowland plain environment also attractive to *A. erythropus*. This continuity confirms that a migration route with rather small numbers but which has now become traditional passes through Hungary (*Sterbetz and Szijj*, 1968), its destination presumably being southeastern Europe. Distribution of records was not uniform earlier either. Years of absence and occurrence in fair numbers alternate. Dynamic migrations were recorded in 1916, 1919, 1921, 1930, 1934, 1935, 1936, 1964, 1965 and 1966 too (*Vasvári*, 1929, *Sterbetz*, 1962, *Sterbetz and Szijj* 1968).

From such a review it is too early to state that the more abundant records in recent years is related to the scattering of the Caspian wintering population. Caution is also advisable because strictly speaking, Hungary is not a goose wintering site. In normal weather from mid-December to late January the conditions are generally unsuitable. There is nevertheless no doubt that on the slightest improvement in the frosty-snowy winter conditions, geese immediately return from the Balkans and southeastern Europe. This is why in the Carpathian basin the concepts of goose migration, wandering and wintering are difficult to distinguish.

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XIII. PRESENT STATUS OF THE *BRANTA RUFICOLLIS* POPULATION AND MEASURES FOR ITS CONSERVATION

A. A. Vinokurov

With regard to the recommendations of IWRB's XXII Board Meeting, work has been done one the study of the present population status and seasonal distribution of *Branta ruficollis* and on the intensification of measures in the field of its conservation.

Organization of work

a) The nesting grounds of *B. ruficollis* in the Arctic regions and its migration areas in West Siberia are vast and sparsely populated. *B. ruficollis* is quite unlike other geese. That is why in the Soviet magazine "Hunting and hunting management" a colour drawing and an appeal to hunters and nature lovers to send information about this species to the All-Union Institute on nature conservation were published in 1977 by A. Vinokurov. The employees of the state hunting inspectorate were also involved in the work of data gathering.

b) B. ruficollis as an endemic species was included in the Red Data Book of the USSR. By this act the attention of ornithologists was drawn to this species. An appropriate appeal was made at the Fourth All-Union Meeting on Anseriformes (Moscow, 1977).

c) In the Central Research Laboratory for hunting management (Moscow), in the Extreme North Scientific Research Institute of Agriculture (Norilsk) and in the All-Union Research Institute on Nature Conservation (Moscow), the study of *B. ruficollis* was included in the programme of research during 1976 – 1980.

d) The following scientists took part in this work in different years: from Moscow: *V. Krivenko, A. Vinokurov, I. Kostin, G. Ivanov, A. Lin'kov* and others; from Norilsk: *V. Zyryanov, V. Dorogov, B. Pavlov, B. Borzhonov, G. Yakushkin* and others; from Sverdlovsk: *N. Danilov, A. Balakhanov, V. Ryzhanovski;* from Melitopolv: *V. Lysenko;* scientists from Astrakhan, Krasnovodsk, Kurgaldzin, Naurzum and Kyzyl-Agach state reserves and also many specialists and hunters-correspondents from various regions of the USSR responded to the appeal.

Direction of research and the amount of work done

a) In the course of expeditions to Yamal, Gydan and Taimyr the distribution of nesting and moulting *B. ruficollis* was investigated. Aerial counts were made from an AN-2 aircraft (in 1977 – 1981 the distance covered by air was more than 35 000 km, about 9000 km of this above rivers at an altitude of 40 – 60 m), from a motorboat (more than 3000 km along the rivers of Taimyr, Gydan and also Yamal). Stationary observations were made in some places on the Rivers Pyásina, Purá, Agápa, Lagáta and Garbóta (Taimyr) and Shchuch'ya (Yamal).

b) Regular observations in March-April and in October-November were carried out in the staging places of *B. ruficollis* along their migration flyway at Manych (Rostov region) and Kalmykien *(V. Krivenko, A. Linkov)*, on the North-Western coast of the Sea of Azov ("Molochny liman"; *V. Lysenko*), in Kyzyl-Agach reserve *(T. Vorobjeva)*. Also examined were the North-eastern Caspian (Turkmenian SSR from Kara-Bogaz-gol to Gassan-Kuli; *N. Skokova* and *A. Vinokurov* in October 1979) and wintering grounds of geese in Kyzyl-Agach and Ak-Gel reserves (*N. Skokova and A. Vinokurov* in October-November 1980).

c) Information received from hunters and specialists about observations of *B. ruficollis* in the nesting, moulting, migration and wintering grounds was analysed (more than 100 answers).

The results of the research

Information, received from expeditions, answers of specialists hunters and also some data collected for the book "Rare, threatened and inadequately known birds of the USSR" (Proc. of the Oka reserve, vol. 13, 1976), made it possible after only a year and a half to prepare and publish an article about the present status and migrations of *B. ruficollis* (*Vinokurov et al.*, 1978 – in English). Unfortunately the map of seasonal distribution of *B. ruficollis* has not been published in this paper.

a) Nesting period

Nesting areas of *B. ruficollis* nowadays extend as before on the Yamal, Gydan and Taimyr peninsulas. Nesting grounds and areas of concentration for moulting are found sporadically (see Map 1). The picture of birds' distribution and their numbers in different places changes from year to year. In different years the correlation of nesting birds (with young) and moulting birds (individuals) changes; this is especially apparent at the northern and southern extremities of the range.

The total number of adult and young *B. ruficollis* in 1978 – 1979 was in the post-nesting period (end of July-August) approximately 22 000 – 27 000 birds. Of these, 17 000 – 20 000 were on Taimyr, 3000 – 4500 on the Gydan, and not more than 2000 – 3000 on the Yamal *(V. Krivenko)*. According to other data (*V. Balakhanov et al.*, 1979; *N. Danilov et al.*, 1977) the numbers of *B. ruficollis* on the Yamal does not exceed 500 – 600 individuals. The Yamal territory is being intensively developed now for natural gas, but there are quite enough nesting and moulting grounds for *B. ruficollis*. On the Gydan and particularly on the Taimyr natural habitats for *B. ruficollis* are more favourable. In recent years there is a tendency to some increase in the population size and habitats of *B. ruficollis*, in particular, the spread of nesting grounds to the East.

Research on ecology

Work has been done on hatching and growth of young, breeding success in various years and on food of *B. ruficollis* (*I. Kostin*, 1981; *V. Zyryanov, B. Pavlov*, 1979; *V. Dorogov et al.*, 1979). Breeding success varies substantially in different years. It was highest in 1976 and 1978 (36 – 38% of birds bred), in 1977 only 4 – 5% bred (the same in 1971). The quantity of young in broods also varies from 4.5 to 7.5 (average over several years – 5.7 young per pair).

Ringing and marking of *B. ruficollis* has not been done on a large scale and it is premature to speak about the results of this work.

b) B. ruficollis migration

The main picture of migrations since 1968 – 1969 has remained without change: *B. ruficollis* flies from the nesting grounds along the basins of the Ob, Irtysh and ToBol Rivers – North-Western Kazakhstan – Northern Precaucasus – Southern Ukraine to the Danube delta (*A. Vinokurov et al.*, 1978; *Yu. Isakov*, 1979). Big concentrations of resting and feeding *B. ruficollis* are recorded in the Ob valley (Oktyabr'ski and Khanty-Mansiyski districts of Tyumen region), on the lake plateau in the area between the upper reaches of the rivers Tobol, Ubagan, Ul'kayak and Turgai (Kustanai region) and on Manych (Precaucasus). The greater part of the *B. ruficollis* population flies between these areas without stopping.

Between Manych and the wintering grounds (in exceptional years *B. ruficollis* is found on Manych even in winter) there are some staging places of *B. ruficollis* where their numbers and length of stay depend on weather conditions.

In recent years *B. ruficollis* has been found in Central and East Siberia; there is a possibility that the birds, having spread to the eastern part of the Taimyr peninsula, are beginning to fly to China to winter.

c) Wintering area of *B. ruficollis*

Information received between 1976 and 1980 about *B. ruficollis* wintering outside the USSR is not sufficient for accurate localisation of the species' wintering grounds.

B. ruficollis is found in winter (apart from Manych and north Black Sea coastal region) from the Danube delta to Evros/Meriç delta. Small groups of these geese winter in Transcaucasus, in Iran, and sometimes in Iraq (see references).

In the USSR in south-eastern regions of the Caspian, conditions are not suitable for wintering *B. ruficollis* (because of the lack of food). In south-

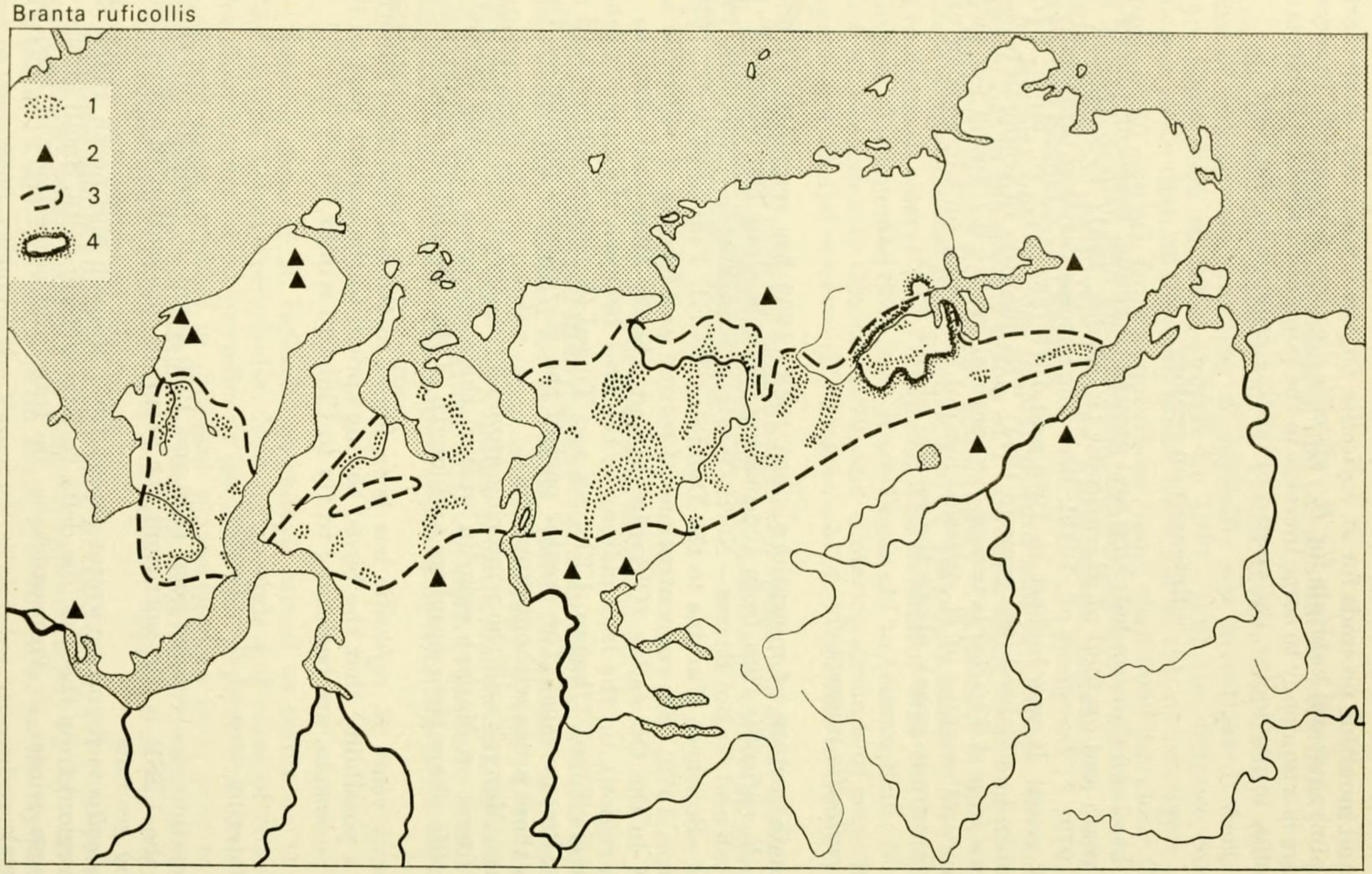

Figure XIII/1: Summer area of B. ruficollis. 1. Areas where nesting and moulting birds concentrate, 2. Scattered pairs and flocks, 3. The boundary of the main territory in summer in 1976–80, 4. Taimyr strict reserve

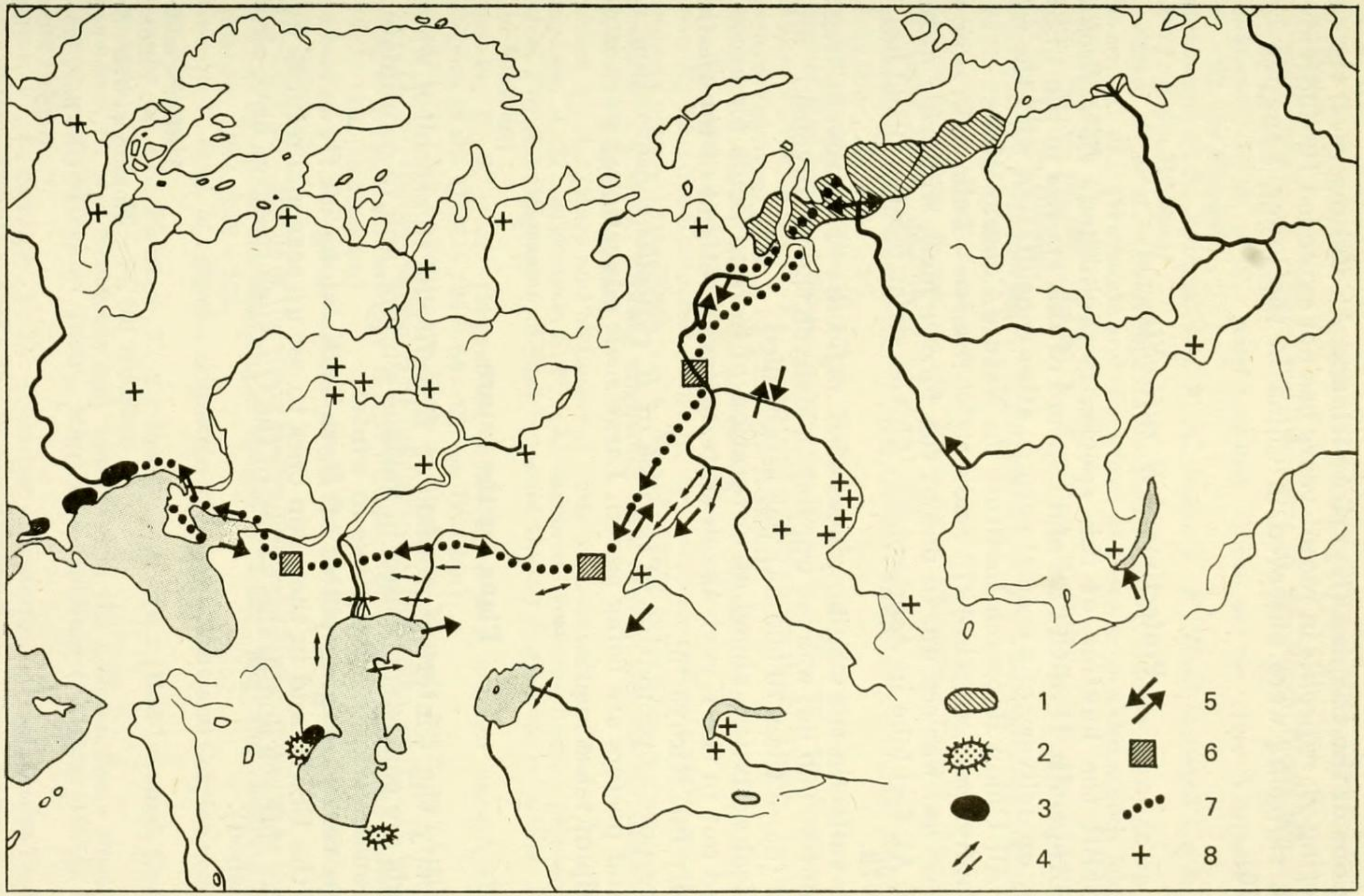

Figure XIII/2: Distribution and migrations of B. ruficollis. 1. Breeding area, 2. Wintering grounds before 1968, 3. Wintering grounds after 1968, 4. Occurrence on passage before 1968, 5. Occurrence on passage since 1968, 6 .Mass staging-points during migration, 7. Probable flyway, 8. Occasional occurrences western regions of the Caspian (Kyzyl-Agach and Ak-Gel reserves) the number of wintering *B. ruficollis* in recent years has not exceeded 100 individuals.

A few *B. ruficollis* were observed in China in the lower Yang-tze basin (*Cheng*, 1976).

Protection of *B. ruficollis*

In the USSR the hunting of this species is prohibited. *B. ruficollis* is included in Appendix II of CITES and capture of this species in the USSR is allowed only on delivery of a special permit, after consultation with the scientists of the All-Union Research Institute on Nature Conservation.

On the Taimyr peninsula in 1979 a new strict reserve – Taimyrski zapovednik (1 324 000 ha) was set up. In one of the former mass wintering areas of *Bi ruficolis*, Ak-Gel lake in Azerbeidzan, Ak-Gel strict reserve (9100 ha) was set up in 1978.

In the Ob valley in the staging places of *B. ruficollis* "Elizarovski" regions reserve (about 80 000 ha) was set up, and at Manych the "Manychski" republic's reserve (more than 70 000 ha) was established.

Biotechnical activities aimed at restoration of feeding fields for geese are being carried out in the Kyzyl-Agach state reserve (wetland of international import "Zaliv im. Kirova").

For the purpose of promotion of the idea of *B. ruficollis* conservation, a lot of leaflets and posters are being issued. Large scale educational work is done with the help of mass media.

Plans for the future

a) To specify the wintering grounds of *B. ruficollis* to establish whether these grounds are consistently used in various winters, and to coordinate the efforts for conservation of this goose in winter.

b) To discover all staging places of *B. ruficollis* along its flyways in the territory of the USSR, and in the main ones to set up seasonal refuges in the main ones (at Manych and in the Valley of the Ob, such reserves have already been established).

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Remark* In these articles are some data about migration, wintering, numbers or biology of Red-breasted Goose.
(A. Vinokurov)

XIV. NUMBER OF BEAN GOOSE *(ANSER FABALIS SP.)* IN THE WINTERING AREAS

M. Fog

The breeding range of the *Anser fabalis* is the boreal and tundra zones from about 75° N to about 60° N (in some areas 50° N) in Scandinavia and USSR. Within the range subspecies have developed. On the European wintering grounds two subspecies are dominating, namely the *Anser fabalis fabalis*, a taiga goose breeding in Scandinavia and western Sibiria wintering in Scania, DDR, Poland, northern part of The Netherlands and Great Britain, and the *Anser f. rossicus*, a tundra goose breeding more to the east and north and dominating on the wintering grounds in Hungary, and southern part of The Netherlands.

Timmermann et al. (1976) state that about 100 000 individuals of *Anser fabalis* sp. are wintering in central Europe, about 4000 in Spain, 40 000 in northwest Europe, and in Great Britain a few hundred.

Number of geese in winter quarter 1977–80

Countings of Bean geese have taken place more or less steadily in many countries, even there is no stable co-ordination of the counting dates. However, the old system of using the week-ends nearest to the middle of the month still functions, and data are kept either by a national co-ordinator or by persons who are specially dealing with the Bean Goose. In some cases data from the latest years have already been published or might be available at the IWRB headquarters.

For this report – the first on Bean goose since my commencement as a co-ordinator of the IWRB Bean Goose Research – the above mentioned sources have been contacted.

It is not possible to give a complete survey on the species in Europe because of the incompleteness of data and lack of exact counting day. Besides the method used for counting varies very much from one country to another.

Best data, however, are from 1977/78 and 1978/79 and therefore chosen as an example. Unfortunately no data were available from Estonia, Latvia, and Czechoslovakia. From FRD only data up to 1976 were present. In Poland only the Slonsk Reserve is counted, but it is said that in autumn 80 000 – 100 000 Bean geese use to stay in Northwest Poland. Great Britain is not in the figure as so very few geese are present. In the winter 1980/81 a total of 165 was reached in Norfolk, the highest number since 1945. Besides 100 were seen in Scotland. From Ireland is stated that Bean goose is not there.

For both years the November counts give the highest number, namely about 200 000 in 1977 and 300 000 in 1978. This must be a minimum size as it is no total count. The main part of the *Anser f. fabalis* were in Sweden and GDR. In both countries neck-banding programmes have taken place during some years. Observations and recoveries have given a hint of the fact that the individuals in those two countries do not mix up very much, so it is very unlike that it should be the same birds counted twice. In other parts of Europe most geese were seen in Poland and Hungary. The data from Poland is a minimum as we know that only one locality is counted. From here – the reserve of Slonsk – two counts however were available, and the number given is an average. From Hungary more data are available, for example 17.11. 1979 and 16. 11. 1980 where 69 000 and 65 000 *Anser fabalis* were present, and in December 1979 and 1980 60 000 and 109 000 individuals were observed. In GDR about 100 000 were present in Nov. 1979.

Comparing these data to those given by *Timmermann et al.* the number of *Anser fabalis* sp. wintering in Europe is increasing. This might be a true increase even may be the countings have been better in some areas.

a) Neckbanding programme, breeding biology study, migratory and moulting study in the Nordic countries within the framework of the Nordic Council for Game Research 1976 – 81

b) Countings are taking place in certain European countries

c) Neckbanding programme in GDR

d) Feeding ecology in Denmark

Table XIV/1.

Number of geese in winter quarter

1977–78	Nov	Dec	Jan	Febr	March
Sweden	42 000	22 000	24 000	17 000	23 000
Denmark	1 000	1 000	3 000	2 000	1 000
GDR about	90 000	*/	40 000	*/	*/
The Netherlands	473	16 000	29 000	45 000	2 000
Hungary	39 000	2 000	25 000	3 000	442
Poland	26 000	11 000	10 000	8 000	7 000
Total	198 473	52 000	131 000	75 000	33 442

1978–79	Nov	Dec	Jan	Febr	March
Sweden	60 000	26 000	12 000	2 000	16 000
Denmark	1 000	2 000	2 000	1 000	1 000
GDR	110 000	*/	4 000	*/	*/
The Netherlands	160	11 000	100 000	76 000	3 000
Hungary	84 000	47 000	7 000	14 000	630
Poland	38 000	49 000	–	–	2 500
Total	293 160	135 000	125 000	93 000	23 130

* not available

e) Hand-rearing and stocking of *Anser fabalis* in Middle and Northern Sweden (WWF etc.), Sweden.

Kalö, October 16. 1981.

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XV. THE STATUS OF THE PINK-FOOTED GOOSE *ANSER BRACHYRHYNCHUS*

M. A. Ogilvie

Introduction

There are two completely separate populations of the Pink-footed Goose in the world (*Ogilvie*, 1978).

1. Breeds in Iceland and East Greenland and winters entirely within Britain.

2. Breeds in Svalbard (Spitsbergen) and winters in Denmark, West Germany, Netherlands and Belgium.

This contribution reviews the past and current status of both populations.

Icelandic—British population

This population has been censused in Britain since 1960, and earlier estimates are available going back to 1950. The censuses are carried out on the first or second weekend in November each year. An earlier census date would be possible for this species because the entire population has usually arrived by the middle of October. However the early November date is convenient for simultaneously censusing the Greylag Goose *Anser anser*, and these do not arrive in Britain until towards the end of October. The Pinkfeet are still very concentrated in early November, though dispersing more widely as the winter progresses.

The census is organised by me and involves up to 100 amateur bird-watchers counting the birds, mainly at the night-time roosts, on the designated weekend. In addition I take part in the actual census, working in areas where there are not sufficient bird-watchers. Much of my time is also spent in gathering large samples of age-ratios and brood sizes in order to assess annual breeding success. Few bird-watchers can be bothered to make such detailed observations.

Table 1 sets out the population totals found in Britain each November since 1950, together with the percentage of young birds. There has been a three-fold increase in the thirty-year period, from around 30 000 in 1950 to the present 95 000. *Boyd and Ogilvie* (1969) and *Ogilvie and Boyd* (1975) have reviewed in detail the population dynamics, status and distribution of the Pinkfeet in Britain, so I will merely summarise some of their conclusions here and bring the story up to date.

The reasons for the large increase through the 1950s and 1960s can be explained partly by a generally good level of breeding success, but probably more by improving conditions for the geese on their wintering areas in Britain. The birds have experienced a steady reduction in the amount of shooting to which they are exposed. At the same time the feeding for them has been

Table XV/1.

Numbers and breeding success of Pink-footed Geese in Britain, censused each November 1950 – 1980

Winter	Total	% young	5-year mean	Winter	Total	% young	5-year mean
1950 – 1	30 000	48.8		1966 – 7	76 500	21.6	
1951 – 2	34 000	24.9		1967 – 8	65 500	10.8	
1952 – 3	35 500	23.4		1968 – 9	65 000	11.7	
1953 – 4	32 500	33.3		1969 – 70	74 000	24.4	17.9
1954 – 5	37 000	34.9	33.1	1970 – 1	72 000	23.1	
1955 – 6	42 000	17.0		1971 – 2	65 000	23.2	
1956 – 7	49 500	18.4		1972 – 3	72 500	11.4	
1957 – 8	36 500	33.6		1973 – 4	82 500	30.5	
1958 – 9	54 000	25.9		1974 – 5	89 000	17.6	21.1
1959 – 60	54 000	20.0	23.0	1975 – 6	73 000	5.6	
1960 – 1	57 700	27.6		1976 – 7	71 000	11.3	
1961 – 2	59 000	37.4		1977 – 8	69 000	8.5	
1962 – 3	56 000	20.9		1978 – 9	78 000	18.4	
1963 – 4	57 000	20.2		1979 – 80	80 000	14.7	11.7
1964 – 5	65 600	26.6	26.1	1980 – 1	95 000	20.6	
1965 – 6	69 000	21.0					

getting better. Over the years a number of the more important goose roosts have received statutory protection leading to a total cessation or a reduction of shooting. Elsewhere the geese have helped themselves by deserting their formerly traditional roosts on estuaries, where there is virtually unrestricted shooting in favour of inland reservoirs and lakes, nearly all of which are in private hands, with either very limited or no shooting. Over the same period the amount of barley and potatoes being grown, particularly in Scotland, has greatly increased, as has the area of improved and fertilised grassland. The geese rely heavily on barley stubbles and harvested potato fields after their arrival in autumn, while grass becomes the preferred food later in the winter, and in the period prior to spring departure.

One of the more striking facts to emerge from this long-term population study has been the decline in breeding success. Also shown in Table 1. are five-year means of the percentage of young showing how it has dropped, particularly in the late 1960s and again in the late 1970s. This decline has been exacerbated by some very low production of young in recent years which can be attributed to very poor weather both in spring and during the breeding season. The overall trend downwards may be related to some long-term climatic deterioration but may equally reflect a shortage of nesting sites. It has been shown, for example, that the principal breeding area in central Iceland may already be overcrowded (*Gardarsson*, 1972).

Boyd and Ogilvie (1969) made predictions, based on counts up to 1968, that the population was quite likely to carry on increasing towards around 90 000 birds by the mid-1970s, though there was a possibility of a sharp downturn. In the event their prediction was fulfilled, which encouraged *Ogilvie and Boyd* (1975) to make further predictions covering the period up to 1980. While they did not accurately predict the quite steep downturn which occurred, they did indicate that the population would not be much above the mid-1970s level by the end of the decade, which has turned out substantially correct.

Conditions on the wintering grounds remain quite favourable for the geese, though there have been increasing complaints of agricultural damage in a few areas. This may lead to the issuing of special licences permitting the shooting of birds in these areas between the end of the normal shooting season and their departure in late April. Overall this probably will not make a great difference to mortality.

Further upward movement seems probable in the long-term, though at a slower rate than in the past. The population remains at the mercy of successive poor breeding seasons, as was seen quite recently.

Svalbard-western European population

This population is present on passage in Denmark in autumn and spring, but winters largely further south, in West Germany, the Netherlands and Belgium. The only complete counts have been made in Denmark, from as early as 1931. Since 1961 the counts have been organised by the Game Biology Station at Kalø (see, e.g. *Fog,* 1980), and in the last few years also by J. Madsen of the Goose Study Group of the Dansk Ornithologisk Forening, who presents a detailed paper on the population at this symposium.

In view of Madsen's paper I will confine myself here to a brief summary of status and draw attention to one or two questions which are raised.

The Svalbard-western European population has trebled since 1931 (see Table 2, based on Madsen's paper), from under 10 000 to the present 27 000 – 29 000. Much of this increase has taken place in two quite short periods, in the late 1950s and in the last four or five years. The former increase is attributed by Madsen to the cessation of spring shooting in Denmark in 1955, while he suggests that the latter is related to increased protection in the wintering areas south of Denmark, and to a run of mild winters reducing mortality.

Age ratio counts have not been made regularly for this population, though in 1980 – 1 Madsen found 24.2% young birds. Paradoxically, after this quite good success, the population fell back slightly from its 1979 – 80 peak of 28 500 to 26 500. In the absence of Pinkfoot age ratios *Ogilvie* (1978) compared the numbers of the Pinkfeet with the breeding success of the Svalbard population of the Barnacle Goose *Branta leucopsis* and showed that there was reasonably good agreement beetwen them. The Barnacle Goose breeding success figures since 1966 – 7 are added to Table 2. After many years of quite good production of young, which fits quite well with movements in the totals of Pinkfeet, the Barnacle Geese experienced two very poor years, in 1977 and 1979. It is therefore somewhat surprising that these are not reflected in the Pinkfoot counts. Indeed in both years the latter increased, slightly in 1977 but by a staggering 42.5% in 1979. There is a considerable, but certainly not total, overlap in the breeding range of the two species in Svalbard and personal observations in 1977 and also in 1981, which has been another breeding disaster

Table XV/2.

Numbers of Pink-footed Geese counted in Denmark since 1931, summarised from Madsen (this symposium).

Also shown are breeding success data for Svalbard Barnacle Geese since 1966 – 1967

Winter or period	Total	Winter	Total	% young Barnacles not recorded
1931 – 32 to		1965 – 66	14 500	
1940 – 41	mean 5 550	1966 – 67	15 000	13.3
1941 – 42 to				
1950 – 51	mean 7 700	1967 – 68	15 000	27.1
1951 – 52	5 000	1968 – 69	12 300	23.2
1952 – 53	10 000	1969 – 70	12 000	27.0
1953 – 54	4 000	1970 – 71	18 800	47.2
1954 – 55	4 000	1971 – 72	12 000	15.0
1955 – 56	5 000	1972 – 73	17 700	28.9
1956 – 57	6 000	1973 – 74	18 000	21.0
1957 – 58	9 000	1974 – 75	12 500	15.0
1958 – 59	no count	1975 – 76	14 000	20.0
1959 – 60	9 000	1976 – 77	16 600	23.0
1960 – 61	16 000	1977 – 78	18 000	2.5
1961 – 62	14 500	1978 – 79	20 000	26.0
1962 – 63 to		1979 – 80	28 500	3.5
1964 – 65	no count	1980 – 81	26 500	27.0

Note that in 1980 – 81 the Pink-footed Geese had 24.2 % young

for the Barnacle Geese, showed there to be very few young Pinkfeet reared in the area visited. This contained some hundreds of Pinkfeet. They seemed to be suffering from the same conditions of very cold, late spring and bad summers which so adversely affected the Barnacles.

Another problem which is raised by the striking increase in the numbers of Pinkfeet passing through Denmark is where are they wintering? Very few geese remain in Denmark after November (see table in Madsen). Counts from the Netherlands over the last six years have produced a mid-winter peak of between 6500 and 12 500 (*Rooth et al.*, 1981, and this symposium). No more than some hundreds winter in Belgium, plus a few in northern France. It would be interesting to learn whether there had been a great increase in the numbers wintering in West Germany where up to 1974 a peak of 8000 was exceptional (*Timmerman*, 1977). There would seem to be a strong case for co-ordinated mid-winter censuses of the Pink-footed Goose throughout these countries, in order to locate the current most important wintering areas and to make sure that they are safeguarded.

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XVI. OBSERVATIONS ON THE SVALBARD POPULATION OF *ANSER BRACHYRHYNCHUS* IN DENMARK:

(a) Numbers distribution and breeding success in 1980/81 and *(b)* Population trends 1931 – 1980

J. Madsen

Report Number 3 of the Goose Study Group of the Danish Ornithological Society

Introduction

The present report presents a preliminary account of a census of the Svalbard population of *Anser brachyrhynchus* in Denmark during 1980/81, and a summary of the evidence on population development during the period from 1941/32 to 1980/81.

The census is a part of an intensive study programme of the staging and wintering goose populations in Denmark, undertaken by the Goose Study Group of the Danish Ornithological Society. The Goose Study Group, which cooperates with the Game Biology Station (Kale), the Zooological Museum of the University of Copenhagen and the National Agency for Protecticn of Nature, Monuments and Sites of the Ministry of Environment, started national goose counts in October 1980. The aim of the study is to provide data on the status of Danish goose haunts, their habitats and goose usage as well as to provide accurate, monthly estimates of the total numbers of geese in the country. The study is an extension of an earlier account of the Danish goose haunts (*Fog*, 1971) and is a continuation of previous and on going recording at the most important Danish bird localities (*Joensen*, 1974, *Ferdinand*, 1971 and 1980, *Meltofte* in press, *Dybbro* in prep.), carried out by the Danish Ornithological Society and the Game Biology Station. The goose study is based on mid-monthly counts, supplemented with as many counts as possible, where the observers map the location of the goose flocks and the agricultural usage of the habitats. At the moment 82 sites are covered.

In addition to goose counts it is planned to make a continous assessment of the breeding success of *A. brachyrhynchus*, *Branta bernicla bernicla*, *Branta bernicla hrota* and *Anser fabalis* staging and wintering in Denmark. A full account of the activities of the Goose Study Group is given in an annual report (in prep.), of which a summary is given by *Madsen* and *Lund* (in press).

Numbers, distribution and breeding success in 1980/81

The Svalbard *A. brachyrhynchus* stay on the west coast of Denmark during autumn and spring on their way between the Arctic breeding grounds and their wintering quarters in the west of Germany, the Netherlands and Belgium. The first flocks usually arrive by the end of September (*Lind*, 1956, *Madsen*, 1980), and the major part of the population stays in Western Jutland till the end of October whereupon the geese leave the country (*Meltofte*, 1973, *Madsen*, 1980). They arrive in the Netherlands by early

November (*Timmermann*, 1977). In mild winters a smaller part of the population may winter in Denmark (*Madsen*, 1980), but the majority of the birds do not reappear until mid March. From mid April to mid May the population is concentrated on the Danish haunts whereupon the migration to the breeding grounds proceeds (*Lind*, 1956, *Fog*, 1977a).

In Table 1. the results of the 1980/81 counts are compared to average numbers in the preceding four winters, when counts were carried out by the Game Biology Station (*Fog*, 1977b, 1978, 1979, 1980). Temperatures were high in mid February 1981, and this gave rise to extraordinarily high numbers of wintering geese. Apart from this, no major difference was found in numbers compared to earlier years.

Figure 1 shows the distribution of *A. brachyrhynchus* during autumn (October to December) and spring (January to May), respectively. The distribution is given in goose-days per haunt (calculated as the multiple of the average number of geese on two successive counts by the number of days between the counts), as this is regarded a better expression of usage than maximum numbers.

In autumn *A. brachyrhynchus* restricted to sites where shooting is controlled, whereas in spring when shooting is banned the geese are more dispersed. Thus, in autumn 91% of the total goose-days were spent at two localities, whereas the same percentage was spent on seven sites in spring. A total of 2 217 000 goose-days were spent in Denmark in 1980/81, the most important sites being Filsø (648 000 goose-days), Vest Stadil Fjord (499 000 goose-days) and Ballum Enge (330 000 goose-days). The dike-building on the Rodenas (Hojer Wadden Sea coast) seems to have affected goose usage drastically. Only 7400 goose-days were spent in the Danish part of the area (against 127 000 goose-days in 1979) before the dike-building (*Gram*, 1981).

The significance of the Danish haunts can be expressed as goose-days in Denmark in relation to the total number of goose-days spent on the wintering grounds (from 1 October to 15 May). Thus Denmark holds 36% of the goose-days (using 27 000 geese as an average population size for the season; see below).

Table XVI/1.

	1976/77 – 1979/80[a]	1980/81
September	1 350	–
October	18 025	17 625
November	1 065	2 606
December	240	344
January	508	224
February	5 725	12 131
March	9 363	12 929
April	15 900	19 339
May	–	1 552
June	–	0

[a]: Average of four seasons, based on *Fog* (1977b, 1978, 1979, 1980)

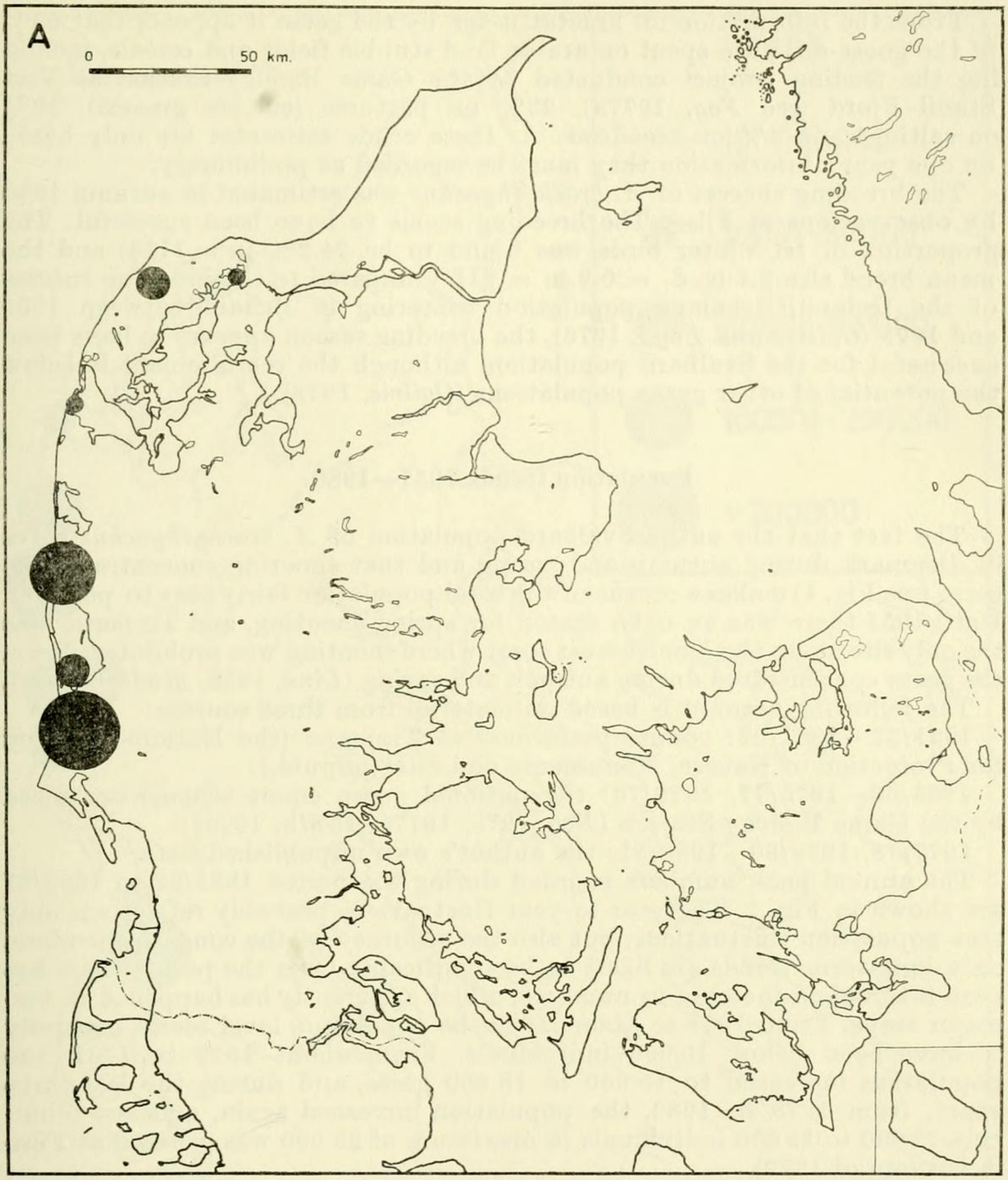

Figure XVI/1 A: Distribution of Anser brachyrhynchus in autumn (October-December) 1980. For key to size of circles, see Fig. 1. B.

From the information on habitat usage by the geese it appears that 63% of the goose-days are spent on arable land stubble fields and cereals, including the feeding project conducted by the Game Biology Station at Vest Stadil Fjord (see *Fog*, 1977a), 23% on pastures (culture grasses), 10% on saltings and 4% on meadows. As these crude estimates are only based on one year's information they must be regarded as preliminary.

The breeding success of *A. brachyrhynchus* was estimated in autumn 1980 by observations at Filsø. The breeding seems to have been succesful: The proportion of 1st winter birds was found to be 24.2% (n = 1114) and the mean brood size 2.4 (s. d. = 0.9, n = 81). Compared to the breeding success of the Iceland/Greenland population wintering in Britain between 1969 and 1975 (*Ogilvie and Boyd*, 1976), the breeding season appears to have been successful for the Svalbard population, although the recruitement is below the potential of other goose populations (*Ogilvie*, 1978).

Population trends 1931—1980

The fact that the entire Svalbard population of *A. brachyrhynchus* stays in Denmark during autumn and spring and that shooting concentrates the geese (see Fig. 1) makes a census of the total population fairly easy to perform. Until 1955 there was an open season for spring shooting, and Tipperne was the only site along the Danish west coast where shooting was prohibited. Here, the geese concentrated during autumn and spring (*Lind*, 1956, *Madsen* 1980).

The following account is based on material from three sources:

1931/32 – 1961/62: counts performed at Tipperne (the National Agency for Protection of Nature, Monuments and Sites unpubl.);

1965/66 – 1976/77, 1978/79: the national goose count scheme organised by the Game Biology Station (*Fog*, 1975, 1977a, 1977b, 1979);

1977/78, 1979/80 – 1980/81: the author's own unpublished data.

The annual peak numbers counted during the period 1931/32 to 1980/81 are shown in Fig. 2. The year-to-year fluctuations probably reflect not only true population fluctuations, but also the accuracy of the counts. Therefore, only long-term trends are likely to be significant. Over the period there has been a threefold increase in numbers, which apparently has happened in two major steps. From 1931 to about 1959 the population level seems generally to have been below 10 000 individuals. From about 1959 to 1961, the population increased to 15 000 to 18 000 geese, and during the last three years, from 1978 to 1980, the population increased again, and now numbers 27 000 to 29 000 individuals (a maximum of 28 500 was counted at Filsø in autumn of 1979).

Studies of reproduction were not carried out earlier, so that the exact nature of the increases is unknown. However, a probable explanation for the increase in the late 1950s is the closure of spring shooting from 1955. The number of geese shot during spring is unknown, but probably the shooting has had both a direct and an indirect effect on the population. Directly as a mortality factor, known to limit the growth of several goose populations, e. g. *B b. bernicla* (*Prokosch*, 1981) and Svalbard *Branta leucopsis* (*Owen and Norderhaug*, 1977). Indirectly, it is possible that spring feeding has a limiting factor, as shooting prevented the geese from utilizing many potential sites.

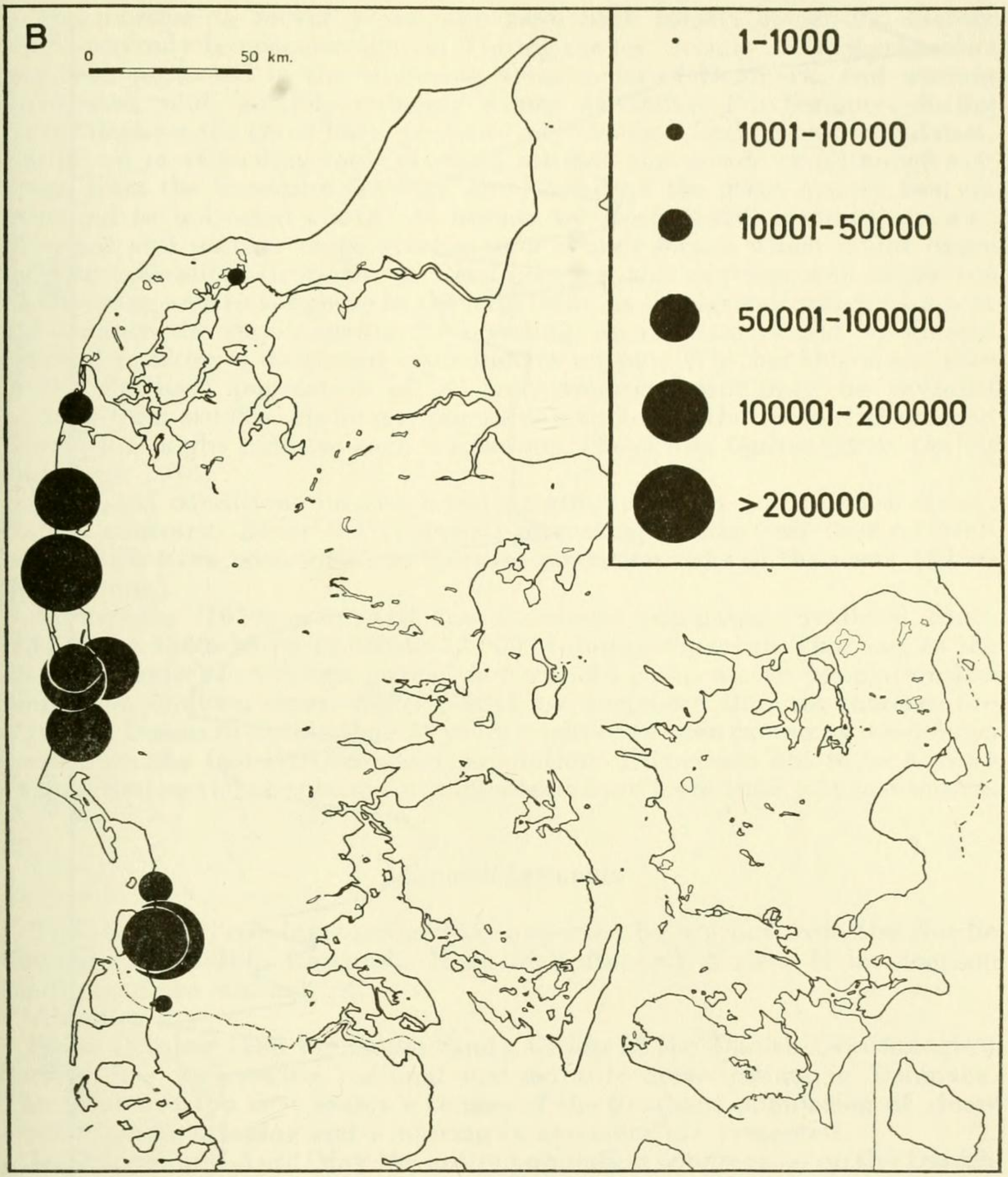

Figure XVI/1 B: Distribution of Anser brachyrhynchus in spring (January to May) 1981. Number of goose-days per haunt indicated by size of circle

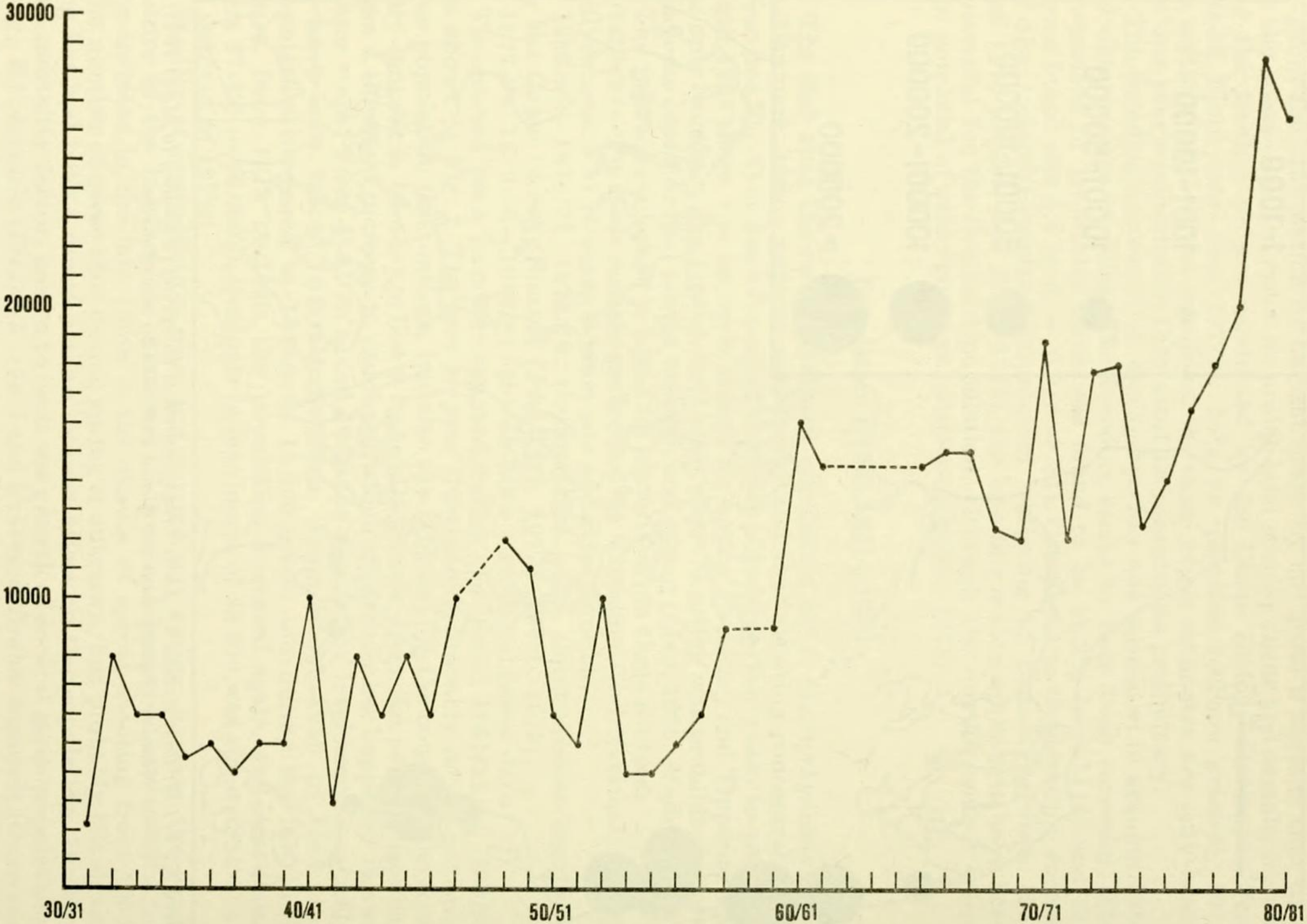

Figure XVI/2: Annual peal counts of Anser brachyrhynchus in Denmark, 1931/32 to 1980/81. Stippled lines indicate years with complet counts

The increase in recent years may have been caused by several factors which can only be speculated upon. During the last decade *A. brachyrhynchus* has been protected in the wintering areas south of Denmark, and winters have been mild, possibly reducing winter mortality. Furthermore, during recent decades the geese have progressively changed feeding habits and diet. Earlier on most feeding took place on saltings and meadows (although evidence from the literature is poor), and nowadays the geese mainly feed on farmland as indicated above. As argued by Reed (1976) a change in diet to cereal and pasture crops gives a safer winter forage which might cause reduced mortality. However, as Reed goes on, this development might not be advantageous to the geese in the long term, as the agricultural diets might not balance the requirements for breeding, an increase caused by greater survival masking a decreased reproductive output. Whether this is the case in the Svalbard population of *A. brachyrhynchus* will only be revealed by long-term studies. However, population trends of the Iceland/Greenland population might indicate such a situation (*Boyd and Ogilvie*, 1969, *Ogilvie and Boyd*, 1976).

Improved conditions on the breeding grounds seem not to be a factor. On the contrary, *Ekker* (1981) reports increasing human activities on Svalbard which have been found to increase predation risks of the nests (*Ekker* pers. comm.).

Norderhaug (1970) estimated the maximum population Svalbard could hold in the 1960s to be 12 000 to 13 000 *A. brachyrhynchus*. This has, as the Danish counts have shown proved not to hold good, as the population has more than doubled since. *Ekker* (1981) has suggested that the increase observed in Denmark during the last years might have been caused by windblown geese from the Iceland/Greenland population. This seems not to be a likely explanation as the population has increased over more than just one season.

Acknowledgements

The study of breeding success was supported by a grant from the Nordic Council for Wildlife Research. Hans Meltofte and Anders Holm Joensen kindly read the manuscript.

Abstract

Since October 1980 the Goose Study Group of the Danish Ornithological Society has undertaken national mid-monthly goose counts in Denmark. The results of the first season's census of the Svalbard population of *Anser brachyrhynchus* staging and wintering in Denmark are presented.

In October and April/May the entire population congregates on the Danish haunts. In autumn, 91% of the goose-days were restricted to two sites due to shooting, while in spring when shooting is banned, the same percentage was spent on seven sites. The dike-building on the Rodenas/Højer Wadden Sea coast has diminished goose usage at the area drastically. A total of 2 217 000 goose-days was spent in Denmark during the 1980/81 season, constituting 36% of the goose-days spent by the population on the wintering grounds. In 1980 breeding was successful: the proportion of first winter birds was 24.2% and the mean brood size 2.4.

Since 1931 the Svalbard population has tripled in numbers. Probably due

to closure of spring shooting in Denmark in 1955, the population increased from about 10 000 to 15 000 individuals in the late 1950s, and since 1977 another increase has brought the population to its present level of nearly 30 000. The latter increase has possibly been caused by protection of the species in the wintering areas south of Denmark as well as mild winters in the 1970s which may have caused reduced winter mortality.

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XVII. STATUS OF *ANSER INDICUS* IN ASIA WITH SPECIAL REFERENCE TO INDIA

P. Gole

Introduction

As we discuss the status of *Anser indicus* in Asia, skeins of these handsome geese should be winging their way to the plains of north India for their winter sojourn. They may be coming from as far as the region of Lake Baikal in the Soviet Union or Lake Koko Nor in China, or from as near as the high-altitude lakes of Ladakh, the northern most part of India. But it is difficult to be precise about their place of origin for no reports of recoveries of ringed or banded geese are available for the last many years. Indeed the most tantalizing thing about *Anser indicus* is that its total range only broadly known and there are many specifics on which information is lacking. An attempt is made in this paper to present the list of information already available, adding the author's own observations of a breeding colony from Ladakh and a summary of reports received from a number of correspondents about its present status during winter in India.

Geese in Ancient India.

In India *Anser indicus* is associated mainly with larger rivers in the north: the Ganges, the Jumna, the Chambal and the Brahmaputra. The goose has attracted man's attention since ancient times, as references to geese can be found in ancient Sanskrit texts. In Rgveda (about 1500 BC) their hissing is compared to the sound made by a burning stick put into water. The great Hindu law-maker of ancient India, Manu, has prescribed penalties for one who killed a goose. They were considered to fly at a lower height than eagles. Ancient Indians know that it was not a resident species but travelled towards the Himalayas annually. Their preference for fresh water was noted and they were believed to subsist on lotus roots. That they spread right up to Mysore in south India, was also known. Their destination beyond the Himalayas was believed to be the Lake Manas (Manaserovar) now in the Tibetan region of China. They were known to return from the north in autumn (Sharad Rtu). Goose echelons are depicted in many ancient carvings, e.g. those in Kangda, Kashmir, Sanchil, Mathura and Taxila (in Pakistan). In mediaeval India they were regularly kept by kings and noblemen in palace gardens and aviaries.

In ancient Buddhist literature also the goose is given an honoured mention as the Buddha was said to have taken the form of a goose to enlighten his disciples. Geese are sculptured on the pedestal at Bodh Gaya where the Buddha received his enlightenment.

In Tibet, according to tradition, geese marry for life and if one of the pair dies, the other pines away and never remarries. Sven Hedin had a similar experience when he shot an *Anser indicus* on Lake Koko Nor. One of my correspondents also experienced the same devotion among the pair.

Total range

According to *Ali* & *Ripley* (1978) *Anser indicus* breeds on high elevation lakes in central Asia from the Tien Shan to Koko Nor but it is a winter visitor to the Indian sub-continent. The northern boundary of their occurrence is said to be the Chu steppe and beyond within Mongolia (it was also taken near Lake Baikal) while the most easterly point of their occurrence appears to be the Chu steppe and beyond within Mongolia (it was also taken near Lake Baikal) while the most easterly point of their occurrence appears to be Lake Bargin in Manchuria. In winter they are most abundant in north-central India becoming scarcer towards Assam in the east and Pakistan in the west. A few winter in Baluchistan to the west and Burma to the east. In Tibet hundreds are supposed to breed on upland lakes and many winter around Lhasa and along the valley of the Taan Po in south Tibet. They are also recorded upto the Altai mountains in the north-west.

A few of the breeding localities are definitely known. According to *Dement'ev* and *Gladkov* (1952) they nest in Dzungaria and Chinese Turkestan while two geese ringed on the nesting ground in Kirghiz SSR were recovered in the early sixties in Pakistan (*Ali* & *Ripley*, 1978). In the early years of the present century Bailey saw many nesting on Rham Tso, a high-altitude lake south of Lhasa in Tibet. They were also reported to breed in cliffs around Lhasa. In the twenties *Osmaston* (1925) and *Meinertzhagen* (1927) found them nesting on a lake near Shushal (Chushul) and around two salt lakes the Tso Kar and the Tso Moriri at a height of over 4300 m in Ladakh.

Migration

From its breeding grounds in the north *Anser indicus* is reported to migrate south in autumn or before the onset of winter. Its return passage is observed in the Tien Shan mountains in late August. By 25 August it is known to leave even the low altitude parts of their northern range. Around Koko Nor also the return passage is recorded on 28 August. There are, however, reports of some birds lingering till late September or even October. In the Pamirs return passage is observed between 19 and 23 September or even October. (*Dement'ev* & *Gladkov*, 1952).

In India the geese appear to arrive on a broad front through northwest Pakistan, Kashmir, Nepal and Sikkim. Recoveries of two ringed birds in Gilgit in NW Pakistan have already been referred to. In this sector they have been observed flying at an altitude of over 4200 m during migration. They start coming in into India by late October and are well in by mid-December (*Ali* & *Ripley*, 1978).

One observed has described their passage through the Himalayas. He saw many *Anser indicus* flying over Bhadwar in Kashmir in autumn heading towards the Chenab and the Tawi rivers and guessed that they probably came from the Tso Moriri and the Pangong lakes in Ladakh, on the other side of the Himalayan range and crossing Lahoul on the way. The birds began flying over after sunset (*Donald*, 1952).

They leave India in March and most are gone by the end of this month, "They leave India as soon as the crops are cut and carried and the stubbles have been pretty well gleaned" (*Hume and Marshall*, 1881). They travel north again on a broad front through the Himalayas from Chitral to Sikkim. Donald saw the geese heading north towards Tibet in February. They flew at night around 2300 hrs and again in early morning at 4000 hrs. Fleming reports from Nepal that one spring he saw about 35 000 ducks and geese flying over the Kosi barrage. While *Anser indicus* headed into the wind right up the river, *Tadorna ferruginea* flew along the wooded ridge. By end of March many were also observed going up the Karnali gorge in parties of 15 to 30 individuals. They went all through the day, in the forenoon, during mid-day, in the afternoon. In the next two hours American Dhaulagiri expedition saw the birds flying at an altitude of over 7000 m (*Fleming*, 1958).

While the geese appear in south Tibet by March end (*Ludlow*, 1944), they start coming in to Ladakh in mid-April. They are known to appear in the region of Koko Nor in mid to last week of March. In Lake Orok Nor in northern Gobi they are recorded from 14 April to the third week of May. In the northern parts of their range, e.g. in Transbaikalia and in the Altais, they appear in early May (*Dement'ev and Gladkov*, 1952).

Earlier records of breeding

Details of the nesting of *Anser indicus* are known mainly from Tibet and Ladakh and to some extent from the Soviet Union.

Though *Hume and Marshall* (1881) over than thousands of these geese breed on the Tso Moriri and other salt lakes of Ladakh, the quotation that they give from Drew mentions only a lake-island frequented by *Larus brunneicephalus* and the existence of a deserted nest believed to be of a goose. *Bailey* (1908) gives a more graphic account of a nesting colony in a marsh adjoining Lake Rham Tso in south Tibet. Here, at a height of about 4500 m he saw many goose nests with eggs on 2 June 1908. They were in a 3 km stretch of a marsh on the south side of Hram village. Most nests were placed on grassy islands surrounded by water 60 cms deep. On a circular island 20 m in diameter he counted 15 nests wich were only slight hollows in the grass lined with down bunched up around them. The number of eggs in each nest varied from 2 to 8, though many contained only 4 eggs. Some of the eggs from larger clutches were discoloured and he believed that they might have been laid during the previous year. He also noticed the promiscuous way in which eggs were laid, for many were lying on the bare grass outside the nests.

Swami Pranavananda (1949) a knowledgeable Indian Sadhu (hermit) who lived for many years on the banks of the sacred Lake Manas in Tibet, saw many geese nesting around the sacred lake itself and also on an island in the adjoining lake, the Rakshas Taal. He reports that they were more numerous on the latter.

Both Bailey and the Sadhu mention that Tibetans collected these eggs for their own consumption and that the eggs were available at the rate of 30 eggs for a rupee. Bailey reports that the birds start coming in by March though he saw eggs laid only in early June. The Sadhu however, states that near the Manas eggs were collected in April. *Ludlow* (1944) saw immense numbers of these geese on Lake Yamdrok Tso in southeastern Tibet though he does not mention any nests.

In 1923 and 1925 Osmaston and Meinertzhagen recorded nesting in Ladakh. Osmaston saw 3 nesting colonies of *Anser indicus:* one on the lake at Shushal (4300 m), one near the salt lake Tso Kar (4600 m) and one on the Tso Moriri (4700 m). At the Tso Kar they were breeding in cliffs, while at the Tso Moriri and at Shusha the nests were on islands in lakes. He observed nesting on the Tso Kar and the Tso Moriri between 8 and 17 June. The cliff nest "was a dense pad of wool and hair resting on sticks, and lined with the down of the Goose". It was earlier used by a pair of *Corvus corax*. The island nests were merely slight depressions in the silt, lined with a little down. The greatest number of eggs in a clutch was six. At Shushal on 3 July, goslings were already out of the nests and were swimming in the lake.

Meinertzhagen saw no nests on 14 June at Shushal, as all the eggs had already hatched. He noted that the mortality among goslings was very heavy due to the depredations of a pair of *Haliaetus leucoryphus*. At the Tso Kar also on 23 June he saw not a single gosling and believed that they also shared the same fate.

Soviet scientists report nests from Dzungaria and Chinese Turkestan and found them among rocks, high in trees and on islands close to banks of reservoirs or on open, swampy plots. Tree and rock nests were constructed of fine twigs with a shallow cup in the middle while in dry bogs nests were made up of moss lined with down and vegetation.

Breeding in Ladakh recent observations: 1976 – 1980

The earliest that I saw *Anser indicus* in Ladakh, was in the beginning of May when small groups (5 – 8) were seen on the Indus river in the south of Ladakh. It is possible that the geese might be following the river once they enter the region beyond the Himalayas. But when I reached the Tso Moriri in the second week of May, geese had already congregated on the lake. The lake, however, was mostly frozen; only a portion of about 1.6 km^2 near the northern shore was free of snow. A small island lies in this part and most of the geese (42 of them) had congregated near the island. They had already paired and scattered pairs were swimming in the lake. The geese had obviously posted sentinels. For, as we approached the lake, two pairs swam ahead and still swimming at a safe distance, protested at our presence with characteristic forward bows punctuated with alarm calls.

A pair also flew over us calling in alarm and the others raised their heads, honking with necks stretched and beaks pointing skywards. However, no nest could be seen on the island. The marsh near the northern shore where a big stream debouches into the lake, was still frozen and there was probably not enough food around.

A few days later I reached the Tso Kar. There were only 10 geese on the fresh-water lake Startsapuk Tso that drains into the Tso Kar. Apparently the whole complement of geese was not present in mid-June. For, in July I had counted about 100 geese on this lake in earlier years. The extensive salt flats of the Tso Kar usually harbour only *Tadorna ferruginea* and not geese.

On the north end of the Tso Moriri also in the third week of July, nesting appears to be over. Here 124 geese were counted. But here as also on the Tso Kar the number of families with goslings was not more than ten, confirming heavy mortality as observed by Meinertzhagen. In late July the geese were undergoing moult as some of the birds that we chased ran towards water and did not fly. In late June and early July geese were also seen on the lake Pangong and on the lake at Chushul (Shushal). But they were not nesting.

In 1980 I reached the Pangong and Chushul in late May. No geese could be seen at both these places. But when our party reached lake Tso Moriri on 8 June, *Anser indicus* were already nesting on the sloping sides of the island near the northern end of the lake. The nests were not mere scarpes in the mud, lined with down. They were rather untidy heaps of vegetation. As I had no means to reach the island, I could not see the lining. The grass-like nesting material had obviously come from the lake itself as there was plenty of aquatic growth in the shallow parts. Even pairs of *Podiceps cristatus* had utilized the same plant to build their floating nests. On the island I counted eight nests on the north-facing slope and about an equal number could be partly seen on the opposite side. A few *Larus brunneicephalus* and a pair of *Sterna hirundo* had their nests on the top of the island.

My observations of the nesting birds showed that only one bird; probably female, alone incubates. The other bird stands guard near the nest or swims nearby. The incubating bird leaves the nest occasionally and goes near the edge of the water to drink or to feed in the shallows. Not all the pairs were nesting however. Some pairs were either swimming and searching for food in the lake while some were just standing and loafing on the island. Sometimes a pair from the lake would take wing and land on the island to be greeted by forward bows from the nesting pairs accompanied by loud protesting calls. One of the birds from a nesting pair was rather aggressive and drove away geese that approached too close to his territory. Once when a raven *Corvus corax* came to inspect the island, he was chased and driven away by a pair of goose and a *Sterna hirundo*. The birds that were feeding in the lake often upended like dabbling ducks. No goslings were to be seen here.

A few days later our party reached the south end of the Tso Moriri. All along the way we saw small parties of geese and one pair with lemon yellow chicks in tow. Apparently this pair must have nested even before the lake became unfrozen, i.e. in the second week of May. A group of 11 geese was also seen foraging in a grassy patch, but the grass was still quite short.

At this end of the lake a small stream that flows in from the south, meets the lake in many channels. The terrain is not marshy but rather it is a plateau of shingle. It stretches south to a considerable distance and may probably have been under water in the recent past as the lake is gradually shrinking.

A few local men with their sheep flocks were camping nearby. They informed us that to the southeast a large number of geese could be found. The geese were said to be nesting and we were assured a liberal supply of eggs if we wished to gather them for eating. We crossed the broad plateau of shingle and coarse yellow grass and Caragana. We then had to cross a small stretch of a shallow marsh. In a muddy depression we observed a pair of *Grus nigricollis*. Beyond this depression was a body of water which was actually a longish arm of a still larger one to the north, a sizeable lake, 3.4 km^2 in diameter and with an island in the middle. As far as we could see it did not appear to be connected to the Tso Moriri. Several geese were seen nesting on the island in the middle of the lake.

The almost square island was about 60 m long and about 60 m wide. The island looked like a flat-topped pyramid with its sides sloping down to the water. About 200 geese had congregated on the island and another 25 were swimming in the lake.

The nests were seen on the flat top as well as on the sloping sides of this island. At some places they were packed closely with hardly 1 m between them. They were scattered at other places. I counted 45 nests on the sides while about 20 birds could be seen incubating on the flat top. Others were just standing and loafing. Here the nests were not made of any vegetation but were mere scrapes in the silt, lined with down which was banked up against their sides. Indeed no vegetation could be seen in the brackish lake and in the vast stretch of sand and shingle around, no fresh grass could be seen.

Observations of these nests also showed that only one bird incubates while the other stands guard. There was some squabbling and agression to be seen between neighbours. Birds from some pairs were rather aggressive. As observed by Bailey some eggs were laid quite promiscuously in the open without any attempt at building a nest. These were lying without any bird attending to them. Some eggs had already hatched and egg-shells were lying scattered on the island. The pairs apparently felt quite safe as the island was deep inside the lake and did not show much alarm at our presence. Unfortunately we lacked any means of crossing the lake and approaching the island. The number of eggs in each nest could not be examined.

It seems that the families leave the island as soon as eggs hatch. This was also noticed by Bailey. I saw only one family with goslings on the island. All the other families with goslings were in the lake. Most of these families had four goslings in tow.

It was not known on what the goslings were fed. There was neither fresh grass nor any vegetation nearby. The lake appeared to be quite deep and without any plant life. But the geese were seen to be vigorously searching for food upending themselves. Apparently insect life should be available. A party of adults which was closely watched from a distance of 30 m fed on small fish and insects that were found in the fresh-water channels. In Tibet the geese were known to feed on a pond weed *Potamogeton pectinatus* (*Ludlow*, 1944). This was available in the estuary to the north end of the Tso Moriri but could not be detected at the south end. It is possible that the goslings were fed entirely on animal matter. The problem however, needs more investigation.

Status in India

In the last century many observers have referred to the abundance of *Anser indicus* in north India in winter. Jerdon in 1877 had said that it was most abundant in the Bundelkhand area and in the region between Agra and Gwalior. Hume saw about 10 000 geese in a 16 km stretch of river near the confluence of the Chambal and the Jumna. This was in the eighties of the last century. In his opinion *A. indicus* outnumbered every other goose in

India by a proportion of 5 to 1. This figure is reiterated by F. Finn in the beginning of the twentieth century. According to *Barnes* (1887) it was abundant in Sind to the west while *Stuart Baker* (1980) says that it was met with in considerable numbers on all larger rivers in Bengal. He saw great flocks in Jessore and Khulna (now in Bangla Desh) in January.

However, later observers did not appear to have seen then in such immense numbers. *Hutson* (1934) says that it was as common as *Anser anser* on the big zheels around Delhi. More recently *Usha Ganguli* (1975) mentions that they were irregularly seen on the Jumna, the largest party seen was of 29 birds. She also saw about 40 birds on the Sultanpur zheel near Delhi.

To asses the present position of these geese in India, an appeal was made through two well-known bird journals of India. Observers were asked to give information on the places and type of habitat used by the geese in winter, their arrival and departure dates, their number and whether it is increasing or decreasing, the probable causes of the same and the food and other habits observed.

The places where these congregate have been reported as, along the Chambal river (thousands), in the Ajmer-Marwar area of Rajasthan (1800 – 2000), the reservoirs at Narora (500) and Etah (20 – 25), the Bharatpur Bird Sanctuary (200), the Sultanpur Zheel (100), the Kaziranga National Park (50) and the Goalpara district of Assam where the geese are mostly seen along the Brahmaputra. While one correspondent expressed the opinion that their number has increased in recent years due to the almost total ban on shooting, according to the rest their number has remained either stationary or has declined. Hunting, encroachment of cultivation and settlement on riverine islands where the geese used to find resting and roosting places and increased prevalence of netting are given as probable causes of their decline.

Their usual habitat according to correspondents remains large rivers and reservoirs. They are seen to associate with other ducks and geese though a party of *A. indicus* generally keeps to itself. Where suitable water-bodies are available geese spread even to the desert where only zerophytic plants are available. Their good in winter is given as paddy and wheat shoots, chana and barley leaves and also some pulses. They are accused of causing some damage to winter crops.

Their arrival is said generally to coincide with Diwwali festival at the end of October or early November and most leave by late March though a few could stil be seen in mid-April.

One observer has described their winter routine: "At night they rest on open sand-bars and in wadis on sand-bars where they can have a clear skyline to show any approaching predator. They fly out at dawn to where they find suitable vegetation. At about 1100 hrs they fly back to isolated Chur (river-island) areas, beaches or sand-bars where the current is fast, bathe and go to sleep. It is then that they are most vulnerable to hunters in boats as they hate to leave the cool beach and fall to the approaching guns. If undisturbed, the siesta continues up to 1400 hrs when they fly out again in search of food. This routine is pretty set. I have never seen them break this".

Status outside India

Detailed information appears to be unavailable on the status of *A. indicus* even outside India. Soviet authors say that though it was once fairly common, in recent years it has suffered a great decline. Outside the Soviet Union the other large area in which these geese breed and winter, is Tibet. However, almost no information is available from regions under Chinese control. Dr. S. Dillon Ripley, Secretary, Smithsonian Institution, who travelled in Tibet in 1980 saw no geese during the spring. According to him, hunting pressure in Tibet should be particularly heavy as almost every young man was seen to carry a gun. He was of the opinion that the numbers in Tibet must have suffered a great decline too.

Nothing appears to be known about the number of geese breeding in Tibet and the rate of their breeding grounds. In Ladakh which actually is the western fringe of the Tibetan highlands, the large breeding colony near the south end of the Tso Moriri appears to be safe from human interference. The breeding colony in the lake near Chushul is no more, though the geese appear still to be holding their own in the Tso Kar.

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XVIII. THE STATUS OF *BRANTA LEUCOPSIS* IN 1980–81

B. Ebbinge

Introduction

There are three populations of *Branta leucopsis* in the world, usually named after their different breeding grounds (*Ogilvie*, 1978; *Owen*, 1980):

– the Russian or Barents Sea population, wintering in the Netherlands and northern Germany,

– the Svalbard population, wintering along the Solway in south-western Scotland, and

– the Greenland population, wintering on the Inner and Outer Hebrides in Scotland and along the north and west coast of Ireland.

Since the species received full protection in the Federal Republic of Germany in 1977, it can now only be hunted legally in parts of Scotland. Under the 1981 Wildlife and Countryside Act, however, it will be protected in Scotland as well, and from then on all three populations will be fully protected from hunting over their entire ranges.

The aim of this paper is to present the most up to date information available on the status of these populations.

The author is most grateful to all who helped in gathering this information, and especially to *R. Beinert, H. Blijleven, D. Cabot, H. Krethe, E. Kumari, M. Lok, M. A. Ogilvie, M. Owen and B. Spaans. M. Ogilvie* and *M. Owen* commented on an earlier draft of this paper.

Methods

Regular censuses of all three populations are made on their wintering grounds, whereas additional counts from the spring staging areas are only available for the Barents Sea population.

Usually birds are counted from the ground, but in special cases aerial surveys are made as well.

Population sizes have been plotted on a logarithmic scale so that changes in the rate of increase are immediately apparent from the figures. Mortality rates have been calculated using ringing recoveries or resightings but also, in periods of a fairly constant rate of increase, from the mean fraction of juvenile birds in the wintering population allowing for the rate of increase in population size, using the following formula:

$$m = j - i(1 - j)$$

where m = annual mortality rate,
j = mean fraction of juveniles in winter,
i = mean annual rate of increase in population size.

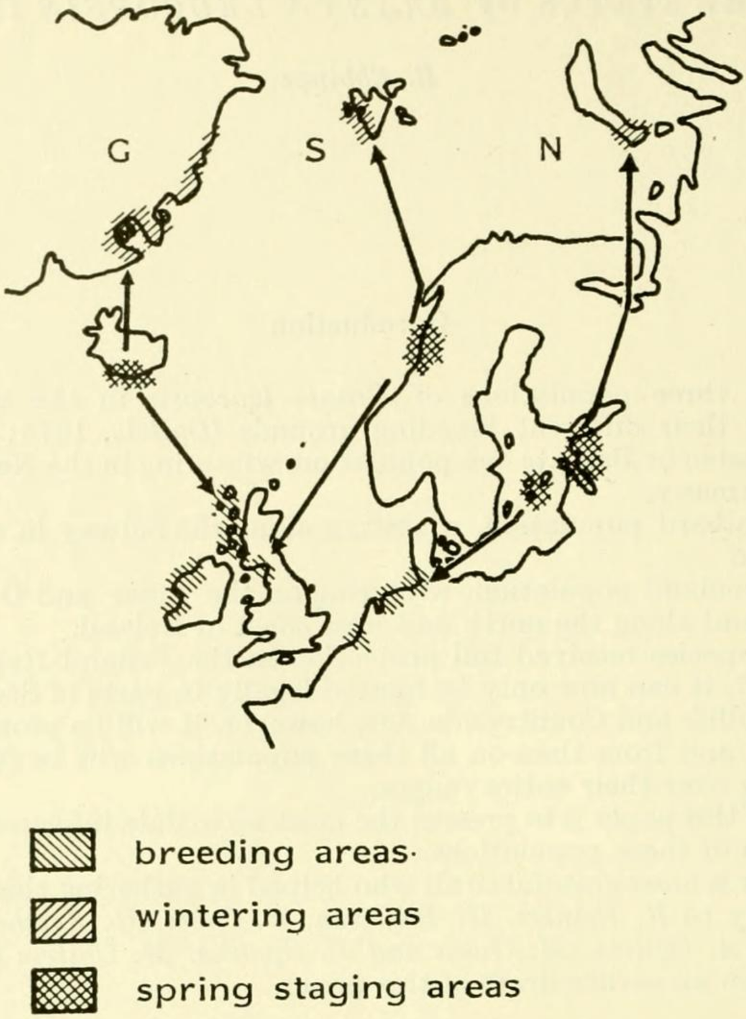

Figure XVIII/1: World range of Branta leucopsis

The mean annual rate of increase (i) is calculated as follows over a period of x years:

$$i = e^{\frac{1}{x} \ln \frac{n_{t+x}}{n_t}} - 1$$

where n_t = population size in year t.

Results

a) *The Russian or Barents Sea population*

Numbers

In the 1980 – 81 season three complete censuses of this population were carried out (Table 1), resulting in a mean of 38 000 individuals. Since the difference between the January count and the May counts can be explained in part by mortality, this mean figure will be too low for the population size in midwinter.

As a check on this figure population size has also been estimated by measuring the density of a known number of individually coded colour-ringed birds (Table 2). The agreement between the two independent estimates is striking and confirms the reliability of the counts.

This means, however, that this population has markedly declined in numbers from almost 60 000 in 1976 – 77 (see Fig. 2) to about 40 000 in 1980 – 81.

Table XVIII/1.

Total census of the Barents Sea population of Branta leucopsis in 1980 – 81

Date	Netherlands	Germany (FRG)	Sweden	Estonian S.S.R.	Total
11 – 1 – 81	41 350[1]	216[2]	–	–	41 500
29 – 3 – 81	?	36 000[1]	?	?	?
7 – 5 – 81	–	–	10 700[3]	25 200[4]	35 900
18 – 5 – 81	–	–	8 300[3]	28 835[4]	37 100

[1] Counts by Res. Inst. Nature Mgmt, supplemented by H. Blijleven and M. Lok.
[2] H. Krethe
[3] R. Beinert
[4] E. Kumari

Table XVIII/2.

Estimate of Barents Sea population of Branta leucopsis in 1980 – 81, using individually marked birds

	Mean:	S.D.:	Sample size:
Density of marked birds:	0.68%	0.48	27 756
Number of marked birds alive:	252		

Population size: $\frac{252}{0.68} \times 100 = 37\,000$ (95 % conf. interv.: 30 400–47 500)

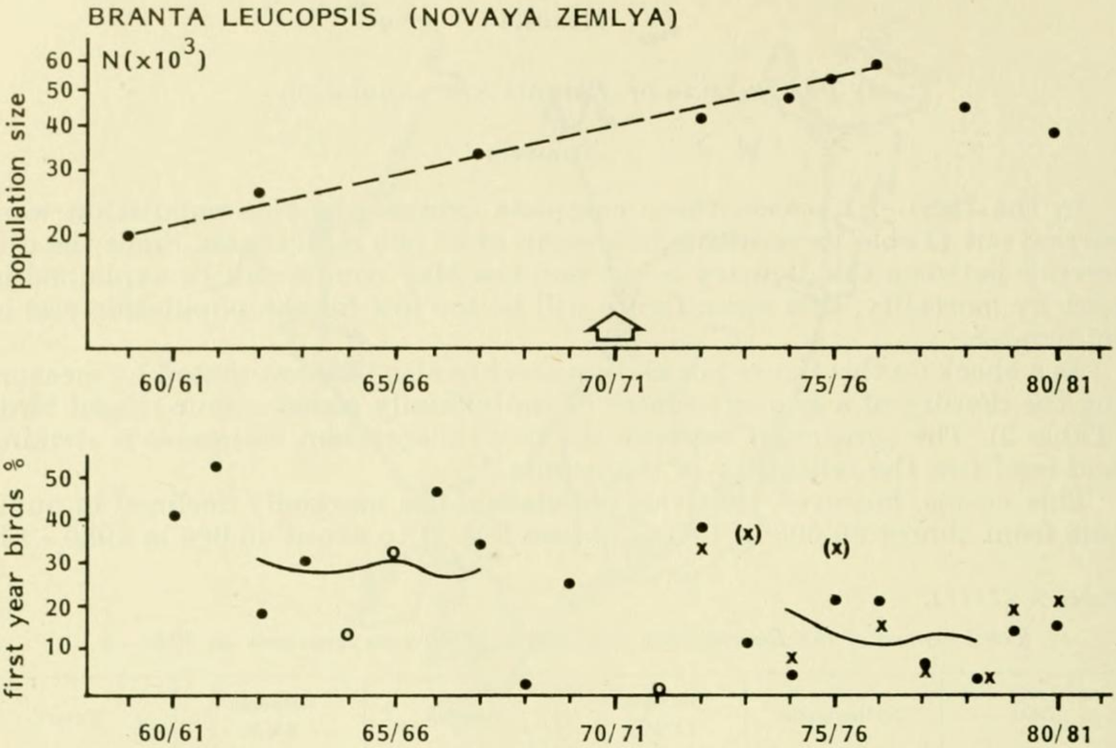

Figure XVIII/2: Change in size of the Russian breeding population of Branta leucopsis in the last twenty years (upper panel). Arrow indicates abolition of spring hunting in the Baltic. Breeding success (lower panel) was measured on the wintering grounds by catching on average 200 birds per season (circles: solid circles indicate a sample size of $>$ 100 birds, whereas open circles $<$ birds). In the last ten years breeding success was also estimated by scanning large samples ($>$ 1000 from grazing flocks crosses). Crosses in brackets are based only on samples from the SW. Netherlands, whereas the others are based on samples from both the northern Netherlands and the sw. part of the Netherlands

Breeding success

In the lower panel of Fig. 2, data on the proportion of juvenile birds on the wintering grounds are assembled. This is based on birds caught for ringing purposes using clapnets. Since in this old-style technique only live decoys and no bait is used to lure the birds into the catching area, this way of sampling is not likely to be biased in favour of juveniles. To check this supposition the age-ratio has been estimated more recently by a second method as well: scanning grazing flocks with high-powered telescopes and scoring the proportion of juveniles in samples of at least 200 birds (see *Ogilvie*, 1978). The results of this latter method have also been plotted in the lower panel of Fig. 2.

The mean values of both methods in the seventies do not differ significantly (paired t-test; $t = 1.44$, $p = 0.20$). The agreement would have been even better if not for two seasons: 1973 – 74 and 1975 – 76. For these two seasons only scanning data from the southwestern part of the Netherlands were available. This area holds on average one third of the whole population in winter, whereas the majority stays in the northern Netherlands and Germany. All clapnetting of *Branta leucopsis* takes place in the northern Netherlands. The discrepancy between the two methods in these seasons could be explained if a higher proportion of juveniles occurred in the flocks wintering further to the south.

To test this I compared five seasons in which age-ratio counts were available for both the southwestern part and the northern part of the Netherlands. Though the means do not differ significantly (paired t-test, 5 = 1.61, p = 0.10), there seems to be a tendency towards a higher proportion of juveniles in the more southern wintering areas: 20% on average in the southwestern part aagainst 13% in the north.

Although the clapnetted samples are almost exclusively from the northern Netherlands they seem to be reliable estimates for the proportion of juveniles in the whole wintering population (see Fig. 1).

When comparing these samples the proportion of juveniles in the sixties ($\bar{x}$ = 31%) is significantly higher than in the seventies ($\bar{x}$ = 15%) (t-test, t = 2.45; p = 0.02).

Mortality

In 1970 spring hunting of *Branta leucopsis* was banned in the Baltic, and in 1977 the autumn hunting of this species in Germany came to an end. Therefore the Russian *Branta leucopsis* population is now fully protected over its entire range. The effect of these protective measurements is illustrated in Fig 3. At present hunting is thought to have a negligible effect on mortality.

Before 1980, when this population was only protected in the Netherlands the annual mortality rate was 26% according to Haldane's method (*Haldane*, 1955). The relevant data are shown in Table 3.

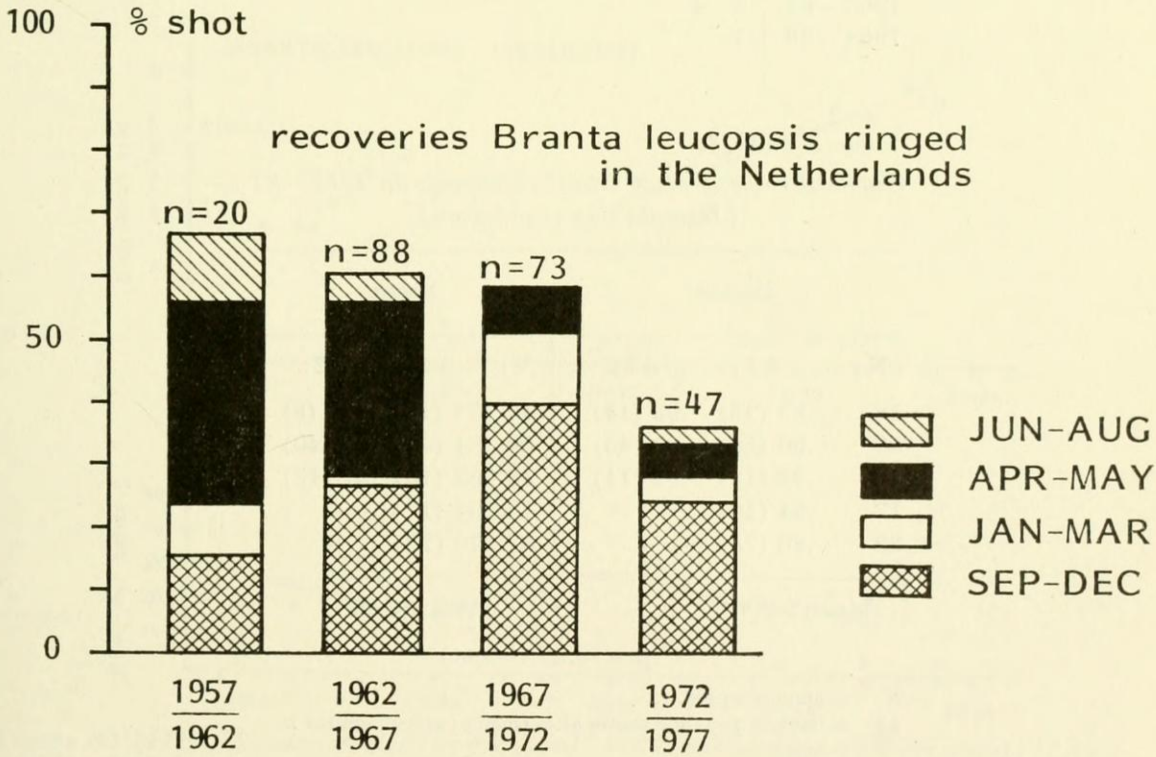

Figure XVIII/3: Decreasing impact of hunting on overall mortality of the Russian population of B. leucopsis during 1957 – 1977.

The present mortality rate can be calculated from the resightings of individually colour-ringed birds (design Wildfowl Trust). This colour-ring program was started in March 1979, and we have adopted the strategy of ringing rather few birds in combination with a high observation intensity in order to ensure that every ringed bird which is still alive will be detected. Table 4. shows

XVIII/3.

Recoveries of Branta leucopsis, ringed in the Netherlands, in 1958 – 1970

Ringing season:	Number recovered (dead) after x seasons: 1	2	3	4	5	6	7	8	9	10	11	12
1957 – 58	5	1	–	–	–	–	–	1	–	–	–	–
1958 – 59	–	–	–	–	–	–	–	–	–	–	–	
1959 – 60	–	1	1*	2	–	1	–	1	–	–		
1960 – 61	–	2	2	1	1	–	–	–	1			
1961 – 62	12	8	3	6	3	1	1	2				
1962 – 63	–	3	3	–	–	1	–					
1963 – 64	1	2	1	1	–	1						
1964 – 65	–	–	–	–	1							
1965 – 66	1	–	–	–								
1966 – 67	10	8	4									
1967 – 68	3	4										
1968 – 69	7											

Table XVIII/4.

Survival rates of adult Branta leucopsis in 1979 – 81 (Barents Sea population)

Females:			Males:		
N:	A1:	A2:	N:	A1:	A2:
18	.83 (15)	.93 (14)	17	.77 (13)	.62 (8)
60	.90 (54)	.80 (43)	58	.81 (47)	.85 (40)
13	.92 (12)	.92 (11)	18	.83 (15)	.87 (13)
17	.94 (16)	–	18	.94 (17)	–
29	.86 (25)	–	37	.76 (28)	–
Mean: .89			Mean: .81		

$p < 0.05$ (t-test)

N = number ringed.

A1 = fraction alive one season after ringing; actual number in brackets.

A2 = fraction surviving from the first to the second season after ringing; actual number in brackets.

the resightings of five different catches of adult birds after one and two breeding seasons. Since there is so little variation in survival rate between the different groups, I presume that virtually no ringed bird has escaped our attention. This is only possible because the occurrence of this species is restricted to rather few sites and a team of about 50 volunteers cooperates in identifying the ringed birds using high-powered telescopes (50x or even more).

Another striking feature in Table 4. is the significant difference in survival rate between males and females, males suffering a higher mortality than females. Imber (1968) documents the same phenomenon in *Branta canadensis*, but *Owen et al.* (1978) suggest the reverse in the Svalbard population of *Branta leucopsis*.

b) *The Svalbard population*

Numbers

This very carefully monitored population (*Owen & Norderhaug*, 1977; *Ogilvie*, 1978; *Owen*, 1980) numbered in 1980–81 9050 individuals (*Owen*, pers. comm.). As can be seen in Fig. 4. this population started to increase markedly in 1971 at a surprisingly stable rate. In this particular year their wintering area on the Solway in southern Scotland was made a special reserve and hunting in Norway and Svalbard was no longer permitted. During the last few years, however, its rate of increase seems to be levelling off.

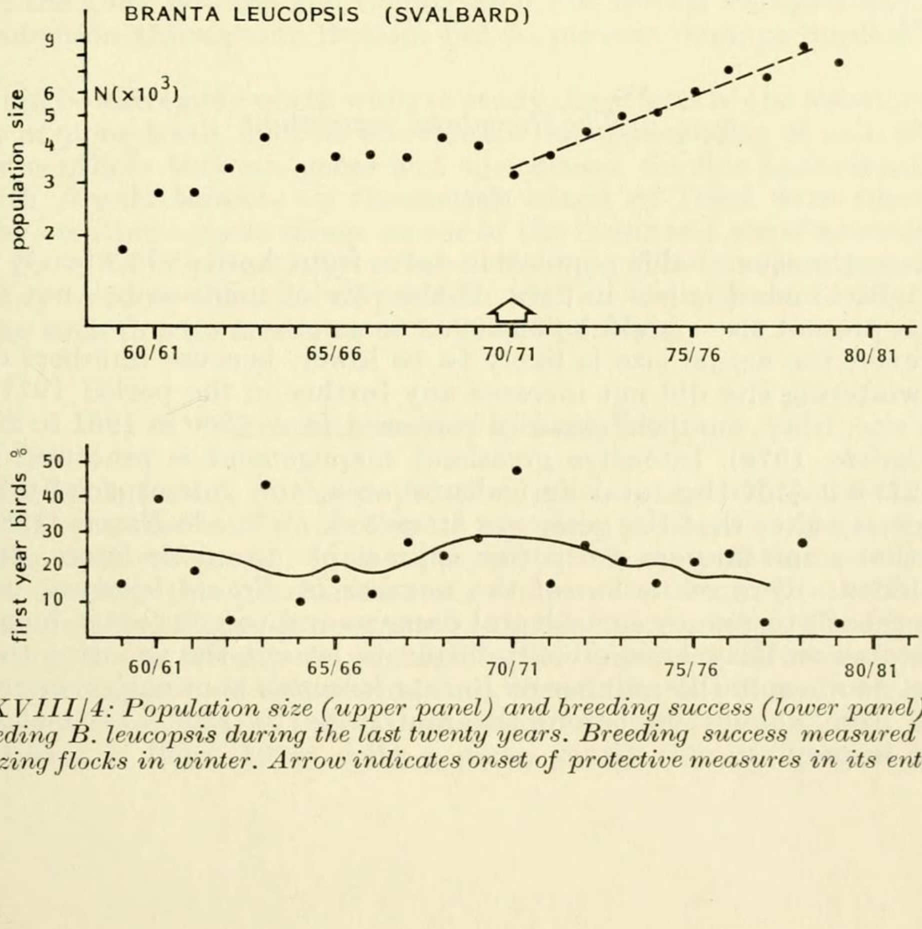

Figure XVIII/4: Population size (upper panel) and breeding success (lower panel) of Svalbard-breeding B. leucopsis during the last twenty years. Breeding success measured by scanning grazing flocks in winter. Arrow indicates onset of protective measures in its entire range

Breeding success

Despite this increase there is no significant decrease in breeding success, as could be observed in the Russian population.

The recent poor breeding results in 1977, 1979 and 1981 are due to bad weather conditions on Spitzbergen (the main island of the Svalbard archipelago) rather than to increased competition for suitable nest sites or moulting areas as a result of the increased population size (*Prop*, pers. comm.). Therefore the recent levelling off in the rate of increase in numbers in the near future is to be expected, particularly because the proportion of juveniles following recent breeding seasons under favourable weather conditions (1978 and 1980) is still high (see Fig. 4, lower panel).

Mortality

Over the last ten years this population increased from 2300 to 9050 a mean rate of 11% annually. The mean proportion of juveniles in this period was 18.2%, and therefore the mean annual mortality rate was 9.2% (see Methods).

An independent estimate of the annual mortality rate is obtained from the annual survival rate of individually marked birds and amounts to 9.8% for adults and 17% for yearlings (*Owen*, pers. comm.). According to *Owen* (1980) the latter method overestimates the annual mortality rate due to probable ring loss.

For further details regarding the Svalbard population the reader is referred to Owen's contribution to this symposium ("Studies of Spitzbergen *Branta leucopsis*").

c) *The Greenland population*

Numbers

The latest census of this population dates from April 1978 when it totalled 33 000 individuals (*Ogilvie* in litt.). If the rate of increase has not changed since, its present size should be 39 000.

However, the actual size is likely to be lower, because numbers on their major wintering site did not increase any further in the period 1977–1981. On this site, Islay, numbers steadily increased from 5800 in 1961 to 24 000 in 1976 (*Ogilvie*, 1978). Intensive grassland management is practised here on 5.2% (2774 ha) of the total agricultural area, and it is especially to these green, grassy sites that the geese are attracted. *Patton* & *Frame* (1981) have shown that some farmers can suffer appreciable economic losses, and have advocated a severe reduction of the number of *Branta leucopsis* on Islay. In trying both to reduce agricultural damage and to gain extra income, the large estates on Islay have already begun to let out the shooting to paying visitors. As a result the number of *Branta leucopsis* shot each winter has increased from about 500 before the mid-1970s to 1200–1400 at present (*Ogilvie*, in prep.).

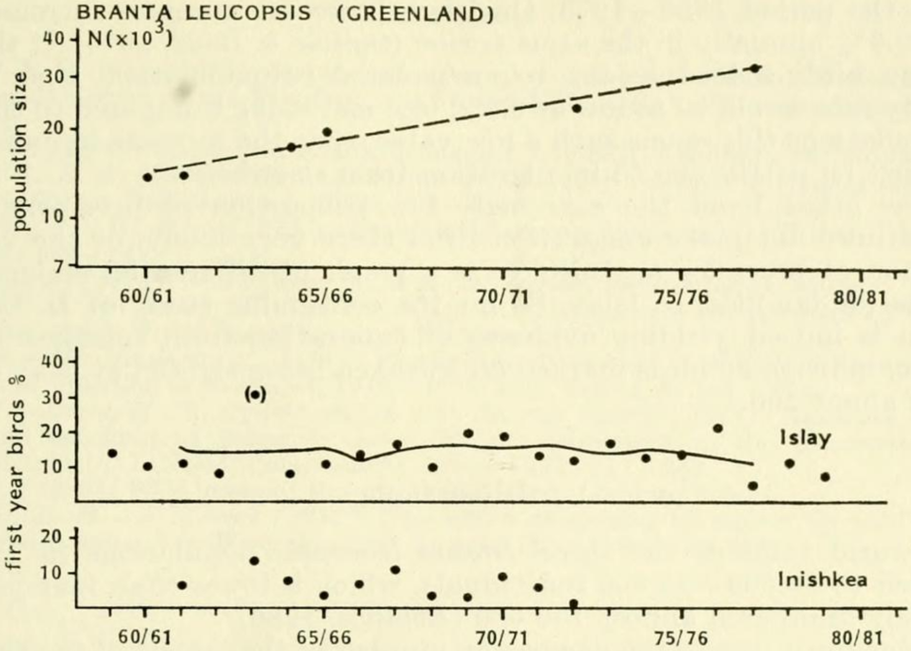

Figure XVIII/5: Population size (upper panel) and breeding success (two lower panels) of Grenland-breeding B. leucopsis over the last twenty years. Breeding success was measured by scanning grazing flocks on two wintering areas: Isaly in Scotland, and Inshkea in Ireland

Since this deliberately increase in shooting pressure, numbers on Islay have no longer increased, but have stabilized at about 20 000.

Under the 1981 Wildlife and Countryside Act *Branta leucopsis* will receive total protection throughout Britain, but to prevent damage licences can be issued.

It would be extremely worth while to study the effects of the measures taken on Islay in more detail, in order to evaluate the applicability of such measures in other conflicts between geese and agriculture. Similar agricultural problems with *Branta bernicla* on the Dutch island of Texel were successfully solved by creating a goose refuge on one of the farms and simultaneously scaring the geese from potentially vulnerable crops. This obviously is a much better way to solve this kind of problem, and should at least be tried before accepting such drastic measures as large scale killing.

Breeding success and mortality

A remarkable feature of this population, when compared to the other two, is the stable, rather low proportion of juveniles throughout the last twenty years (Fig. 5, lower panel). In the fraction of this population wintering on Inishkea, Ireland, this phenomenon is even more striking. Do the Islay and Inishkea wintering birds form separate subpopulations with different rates of increase, or is the Greenland population concentrating more and more on Islay at the expense of other wintering sites? On all other sites along the Scottish westcoast and in Ireland, numbers are very stable (*Cabot* & *West*, 1973; *Ogilvie* & *Boyd*, 1975), with a mean yearly rate of increase of only

0.2% in the period 1956 – 1973. On Islay, however, numbers increased at a rate of 9.9% annually in the same period (*Ogilvie* & *Boyd*, 1975). If the Islay wintering birds indeed belong to an isolated subpopulation, their annual mortality rate would be as low as 6.8% (see methods). Compared to the other two populations this seems such a low value, that the increase in numbers on Islay must be partly due to immigration from elsewhere.

On the other hand the extremely low proportion of juveniles on e.g. Inishkea does not make emigration from there very likely, or the very low proportion of juveniles on Inishkea is a result of differential emigration of juveniles (or families) to Islay. So far the continuing study of D. Cabot on Inishkea is indeed yielding evidence of emigration from Inishkea to Islay (*D. Cabot* in litt.), 20 birds marked on Inishkea being sighted at Islay out of a total of about 200.

Discussion

The world total of the three *Branta leucopsis* populations in 1980 – 81 amounted to 80 000 – 90 000 individuals, which is lower than four years ago when they numbered almost 100 000 (*Ebbinge*, 1980).

This decline is due to the decreasing number of the largest of the three, the Russian or Barents Sea population, but the increased hunting pressure on the second largest population, the Greenland one, may have caused a decline in this population as well. However, no recent full counts of this latter population are available since April 1978. In the Russian population the proportion of juveniles has decreased significantly in the last twenty years. Decrease of reproductive output in a growing population is also observed in other goose species, e.g. the Icelandic *Anser anser* (*Owen*, 1980), and might be a result of increased intraspecific competition.

The other two populations do not show a marked decrease in their breeding success. The smallest, and most rapidly growing population, breeding on Svalbard, still has a fairly high reproductive output, whereas the larger Greenland population has, ever since the Wildfowl Trust started its monitoring program in 1959, been characterized by a low and rather constant reproductive output.

To find a way to solve present conflicts between agriculture and *Branta leucopsis* wintering on Kslay (west Scotland), more research is badly needed. Especially scaring activities (including shooting) should be carefully monitored as to their effects on the geese.

Apart from the studies already mentioned in last year's report on *Branta leucopsis* (*Ebbinge*, 1980), L. Gustafsson from the Zoological Department of the University of Uppsala will start a special study on the influence of spring feeding on subsequent breeding success (financially supported by the Swedish W. W. F.) in close cooperation with the I. W. R. B. – Barnacle Goose Research Group.

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XIX. THE STATUS OF *BRANTA B. BERNICLA*

A. K. M. St. Joseph

The table accompanying this paper gives the present status of each of the six commonly recognized populations of *Branta bernicla* to be found around the northern hemisphere. Being a species with a completely circumpolar distribution there are obvious reasons why it is useful to have available from the IWRB the relevant population surveys and age ratio statistics.

The Brant research group is co-ordinated by the IWRB. It is composed of corresponding members who actively take part in research on, or management for, this particular species. Two recent conferences (The 1st and 2nd Technical Meeting on Palearctic Migratory Bird Management, Paris 1977 and 1979) drew international attention to a number of problem areas. Some of those requiring further attention are itemised under "Comments" and a slightly longer explanation is given below.

B. bernicla nigricans in Japan

The full distribution of this population is not completely known largely due to the lack of information from North Korea. Age ratio surveys have been conducted for a number of years and it is hoped that this information will shortly be available.

Puget Sound, Washington State, USA

It is now well known that the majority of West Coast *B. bernicla* migrate almost directly from Alaska to Mexico and that disturbance due largely, it is thought, to hunting pressure, has resulted in very few birds wintering north of the Mexican border. The exception is a small group of "gray" *B. bernicla* that remain throughout the winter in the Puget Sound area. Neck-banding in recent years has shown that this population comes from the Queen Elisabeth Islands, NWT, Canada and numbers no more than 5000 birds. It is clearly a matter of concern that so small and apparently so distinct a group of birds should be subjected to hunting because it is mistakenly considered to be part of the much large population of *B. b. nigricans*.

Strangford Lough, Northern Ireland, UK

Strangford Lough is the first major resting place of the population of *B. b. hrota* which breeding in high Arctic Canada migrates across the Atlantic to winter in Ireland. While conducting the autumn age ratio surveys there in 1980, continual disturbance by hunters (shooting *Anas penelope*) was observed. Not only was the capacity of Strangford Lough to hold A. penelope affected but the availability of *Zostera* to *B. b. hrota* was also reduced at a time of relatively high food requirement after the long autumn migration.

Branta b. hrota in Denmark.

The Danish representatives have indicated that a short open season on *B. b. bernicla* may soon be permitted in their sector of the Wadden Sea. It is generally considered that this population is large enough to stand harvesting and the Danish hunting system sufficiently well controlled to be able to undertake such a responsibility.

However, it is of major concern that the small population of Spitzbergen breeding *B. b. hrota* (numbering less than 2500) does overlap during the likely hunting period in the Wadden Sea, although it spends most of the winter in Mariager Fjord. It is hoped that sufficient precautions will be taken should such an open season be implemented.

Branta b. bernicla in Western Europe

Reclamation in Federal Republic of Germany of the spring feeding area of this population is continuing and it seems inevitable that 15 000 individuals will be displaced. Such habitat loss is extremely serious and although the retention of the Leybucht is welcomed it is not felt that the overall outcome in Federal Republic of Germany is satisfactory.

Table XIX/1.

Status of Branta bernicla

Subspecies	*Range*	*Population size*	*Comments*
Nigricans	Siberia – Japan	< 1 000	– More in N. Korea?
Nigricans	Siberia (Alaska) Canada – W. USA, Mexico	c 200 000	– Autumn hunting in Puget Sound
Hrota	Canada – E. USA	97 000	
Hrota	Canada – Ireland	< 10 000	– Conflict with excessive wildfowling for *A. penelope* in Strangford Lough
Hrota	Spitzbergen – Denmark	< 2 500	– Possible conflict with autumn season on *B. b. bernicla*
Bernicla	Siberia – W. Europe	147 000	– Continued reclamation, crop damage and licensed shooting

Information from: Y. Yokota, H. Boyd, A. Reed, O. Merne, A. Vinokurov, M. Fog, P. Prokosch, B. Ebbinge, R. Maheo.

In the United Kingdom farmers will soon be able to apply for licences to shoot *B. b. bernicla* to prevent damage to crops. The conditions under which such licences would be granted have yet to be finalised.

Copies of the Proceedings of the First Technical Meeting of Palearctic Migratory Bird Management are available from IWRB, Slimbridge, Glos, UK Price £ 5.00

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XX. ECOLOGICAL ASPECTS OF THE OCCURENCE OF GEESE ON LAKES OF THE GDR WITH RESPECT TO SOME HYGIENIC PROBLEMS

L. Kalbe

The waterfowl research program dailing with the distribution of Geese in the GDR under the direction of Prof. Dr. Rutschke creats some ecological questions, too. In this case investigations were made into possible negative and positive effects of feeding in agricultural areas with a greater number of Geese, investigations into influence on the trophy of waters through the import of nutrients, into the daily rhythm and the radius of action of resting geese at the resting and sleeping sites, and into the ecological demands of the Grey-lag Goose on breeding sites.

Some of these questions have been answered satisfactorily and have led to important results, e. g. from *Naacke* (1966, 1973), *Rutschke* (1964, 1978), *Schröder*, (1973), *Frädrich* a. *Naacke* (1974), *Bersiner* (1976), *Litzbarski* a. *Loew* (1976), *Rutschke* a. *Schiele* (1980).

Further aspects and results will be dealt with now.

I. Marking of ecological conditions at the resting and breeding sites of geese

It is an essential advantage of our Centre of waterfowl research that we have access to good ecological characteristics of all larger waters, firstly in the Register of waters of the GDR, secondly in the Katalog of wetlands from international and national importance for waterfowl. This gives us the possibility of knowing and of finding out the relevant ecological factors for the occurence of geese. But of the very small breeding waters of the Grey-lag we know only too little. Unfortunately, just many of such waters are occupied, e. g. small ponds, lakes and peatlands. So the picture of Grey-lag's ecology must still be incomplete.

Resting sites of the Bean Goose and White-fronted Goose

There are about 90 resting sites in the GDR covered by geese every year. They are concentrated in the northern and central districts. Most of them are natural lakes. In the southern parts of the GDR there are especially smaller ponds and other artifical waters, e. g. impoundments and remainder waters of Brown Coal Mines. We have prepared an analysis of the ecological conditions with regard to the largeness of lakes on ponds, to the depth of waters and to the trophy (Table 1 – 3).

Table XX/1.

Largeness of resting sites of the Bean and White-fronted Goose in the GDR (number of waters = 75)

Degree of largeness (area)	Number of (lakes and ponds) resting sites	Number of waters in the GDR total (without ponds and running waters)
20 ha	4 (ponds only)	800
20 – 99 ha	16	480
100 – 299 ha	28	65
300 – 999 ha	19	55
1000 ha	8	14

Table XX/2.

Depth of sleeping sites of the Bean and White-fronted Goose in the GDR (number of waters = 75)

Degree of maximum depth	Number of resting sites	Degree of average depth	Number of resting sites
2 m	21	1 m	19
3 – 10 m	29	1 – 3 m	33
11 – 30 m	19	3 – 10 m	17
30 m	6	10 m	6

Table XX/3.

Trophy of resting sites of the Bean and White-fronted Goose in the GDR (number of waters = 75)

Scale of trophy	Number of resting sites	% resting sites	Total numbers of waters in the GDR (%) (lakes)
oligo-mesotrophic low eutrophic	3	4	1
deep lakes	11	15	9
shallow lakes	13	17	7
eutrophic	39	52	73
high eutrophic	9	12	10

A comparison of the results shows that depth as well as largeness as trophy of waters are not important for geese. Nevertheless, it is obvious that the larger lakes are preferred. There are 14 very large lakes with a surface of more than 1000 ha in the GDR. 8 of them are resting sites of geese. If there are larger lakes in an area the geese will accept them, too.

A total of about 70% of all resting waters are larger than 100 ha, although there are more than 1250 lakes with a smaller surface (= 90%), and about 135 lakes with an area of more than 100 ha (= 10%) only. The smaller resting sites, e. g. Lake Grössin in the district of Potsdam, have other neighbouring lakes which the geese can fly if they are disturbed, for instance through hunting or fishing.

Moreover, the geese prefer lakes with lower trophy and smaller depth probably. With regard to the trophy we must consider that in autumn and winter the lakes have clear water without phytoplancton and other loading substances so that the characteristics of those lakes are quite similar to lower eutroficated lakes. Therefore we must find out other important factors for the occurence of geese at waters, too. I think, the best ecological conditions are the following:

– Territorial position of resting sites near good feeding grounds like alcaline peatlands, grasslands and agricultural areas with wintercorn in the middle in an area of 15 km to the resting ground.

– Existence of small wooded shores and shallow shores.

– No disturbance at the resting waters in the evening, if they come back to the lake.

Resting sites of Grey-lag

The situation of resting sites of Grey-lag differs greatlier. The change from one of resting site to an other in the various seasons, e. g. in spring by non-breeders, in summer and in autumn by migrating geese has been investigated e. g. by *Frädrich* a. *Litzbarski* (1975, 1976). However, the conditions of resting sites preferred by the Grey-lag are the same as those of Anser fabalis and Anser albifrons. Firstly, we have some large lakes (Lake Krakow, Lake Gülpe, Lake Plau and Lake Schwieloch) which will be frequented by the Bean Goose and White-fronted Goose together with the Grey-lag at the beginning of autumn. On the other hand, we have found many smaller waters like ponds, peatland and small lakes as resting sites of the Grey-lag, too. It is very difficult to find out the essential ecological criteria of the Grey-lag's resting waters. But we think the ecological conditions are quite similar to those of Anser fabalis and albifrons.

Breeding sites of the Grey-lag Goose

W The stock of the breeding population has increased since 1960 in the GDR Te have estimated the number of breeding sites to more than 450 – 500. his is the background for investigations of the ecological conditions of the. breeding sites. The results of first investigations are still unsatisfactory.

It is a fact that the ecological conditions that are favoured by the Grey-lag are not measurable with the general status of the waters, e. g. trophy, depth, largeness, water quality. This species is very strongly dependent on the terrestrial conditions in the feeding grounds, not on limnological conditions and especially not on waterchemistry or waterbiology. This is an important difference with regard to other wildfowl. On the other hand, it is necessary to have a highly structured vegetation on shore and good attainable feeding grounds near the waters. These are the suppositions of settlementation of waters by geese (see also at *Hudec* a. *Rooth*, 1970). In the GDR the main ecological characteristics of waters covered by geese are the following:

– Alternation of dense and loose shore-vegetation mainly composed by Phragmites, Typha, Salix and other underwood

– Shallow water near the shore

– Existence of islands and dams with a high density of plants

– Strong structuration of the shoreline

– Possibilities of getting out of the water at shallow shores without vegetation by geesefamilies.

– Existence of feeding grounds near the water.

II. Effects of a high density of Geese on resting sites

The problem of eutrofication

Dobrowolsky (1973) and *Kalbe* (1978) have shown that the import of nutrients and organic substances can bring forth some negative effects in water-ecosystems (eutrofication, oxygen consumption). But theoretical model-investigations have proved that the load by waterfowl is not so high. The whole balance of nutrients and the turnover of substances in the ecosystem will be determined mostly by other processes, e. g. by the import of nutrients, by sewage and wastewater, imports of phosphorus and nitrogen by agriculture and fishery. So we cannot find any limnological model of substances which regards the import of nutrients by geese and other waterfowl today. But it is imaginable that there is a negative influence on the status of eutrofication by geese with regard to the following conditions:

1. High density of waterfowl with a high grazing rate of plants followed by an increase in the turnovei of nutrients, especially in summer. The negative effects may be: Intensive development of phytoplancton, water disturbance, development of waterblooms, decrease of transmission of light into the water. Doubtlessly this will only arise in special situations, because the feeding of waterplants brings forth normally a decrease of nutrient contents in an ecosystem. It would be necessary to have a sudden immigration of high numbers of waterfowl only. In our area we have not found any such situation up to now.

2. Another point of view is the presence of many waterfowl are fed outside the waterecosystem and then fly to the water there, where they put their excrements with nutrients into the water. This refers to geese and gulls.

Rutschke and *Schiele* (1980) have done research in this field at Lake Gülpe with regard to Bean Goose and White-fronted Goose. In the autumn there are 10 000 and more geese at the lake. *Rutschke* and *Schiele* have found that 10 000 geese will import 2,2 kg P and 5,2 kg N to the lake daily, which in 40 days from the middle of October to the end of November amount to a total of 88 kg P and 208 kg N. The lake has an area of 600 ha and an average depth of 0,5 m. It contains 3 million m^3 of water, with 450 kg P and 300 kg inorganic and organic N dissolved in it. From the faeces of the geese, the lake gets nearly 20% of the total amount of P dissolved in the water. The increase of nutrients content in the lake Gülpe would doubtlessly be the beginning of eutrofication with negative conditions. *Rutschke* and *Schiele* refer to the modelcharacter of this account explicitly because the accumulation of nutrients in about 40 days is possible only if we do not have anything that changes the quantity and quality of water in the lake. Actually, a small river, the Rhin flows through the lake with the waterflow of 4 to 6 m^3/sec during resting time. Therefore the average time of stay is 6 to 10 days only and the accumulation of nutrients is possible about 6 to 10 days only, too. Moreover, the import of nutrients goes on mainly in autumn and winter, so that the metabolism of matter is decreased.

Nevertheless, the example shows that especially with small loaded lakes without an exchange of water resting geese can bring a high degree of eutrofication with changes for the worse of the ecological conditions for other waterfowl. Especially some of the smaller shallow lakes with a well-developed submerged waterplant-vegetation are endangered. In the GDR the following lakes belong to this type: Lake Putzar with 19 000 geese the maximum, Lake Koblentz (8000 geese), Lake Breesen (4000 geese), and Lake Felchow (20 000 geese). It is possible, that the defense against geese is necessary for the preservation of the good ecological and limnological condition of these waters.

It showes a calculation for the lake Felchow, a small lake with an area about 40 ha.

Largeness of lake: 40 ha
Middle depth: 0,5 m
Volume of water: 0,2 million m^3
Import of nutrients: 88 kg P, 208 kg N
Load of surface: 0,22 g P/m^2·a, 0,32 g N/m^2·a
Critical loads according to VOLLENWEIDER (1968): 0,07 g P/m^2·a,
1,0 g N/m^2·a
Critical loads according to KALBE (1976): 0,13 g P/m^2·a,
1,0 g N/m^2·a
This loads surpass the critical value of 0,07 g P/m^2·a.

Hygienic aspects

Wild geese are, like other ducks or gulls, potential carriers of Salmonelloses (Typhus, Paratyphus, typhoid Fefer). The possibility of infection of man will be diminished at time of migration of geese (September to April). At this time we can eliminate the possibility of infection during recreation activities of people (for instance bathing). Greater danger could come from abundant resting Grey-lag geese at beaches in summer.

Excrementation at such places may be very problematic. In the GDR we have not found any infections of man by geese, fortunately.

An other point of view is the hazard to waterfowl by Clostridium botulinum in highly eutroficated waters in summer, and also the potential infection by man. This problem has been investigated by *Feiler* and *Köhler* (1976) with regard to the area of the river Havel.

III. Importance of Geese as Bioindicators

The term bioindication of loads or of hazards and of the stability of ecosystems has found its way into many branches of ecology in the last decades. Whereas bioindication of air pollution and of water pollution has been used by forestry and water management for a long time already the importance of birds as indicators has not been known up to now. Of course, ornithologists have pointed out the possibility of indication of biocids by birds as consumers of the second or third compartiment of the feedchain, but theoretical considerations on the possibility of general bioindication by birds have been published by *Rutschke* and *Kalbe* (1980) at first recently. So, birds are good indicators, although there are some difficulties because normally birds show changes in their distribution:

– The homothermy and intensity of metabolism are suppositions for the strong dependence of populations on environmental factors. Birds are very sensitive to them.

– The position of most species of birds in the ecosystem has been well defined, and so it is possible to find out changes of the environment.

– Qualitative and quantitative changes of the birdfauna can be accessed easily.

The geese as relatively spectacular birds have a special position in this case. The value of indication will decreased radically by reason of the lower position in the feedchain (second compartiment as consumers of the first step). The indication of pollutants by the feeding of contaminated plants is well-known, e. g. for mercury and other toxic salts of heavy metals.

Above all, the breeding population of Grey-lag has a great importance as indicator of the whole changes in waterecosystems, if we want to review the variety, stability and mechanisms of regulation as suppositions for the preservation of landscape. The Grey-lag is an important member of many waterecosystems in the GDR. In connection with the typical combination of species the Grey-lag indicates a generally variable landscape although it shows only little dependence on limnological ecofactors. The typical fauna of birds of a natural shallow lake with clear water would be characterised, e. g. by the following combination of species:

Anser anser – Anas platyrhynchus – Anas querquedula – Anas crecca – (Anas acuta) – Spatula clypecta – Podiceps ruficollis – Podiceps nigricollis – Podiceps cristatus – Rallus aquaticus – Gallinula chloropus – Fulica atra.

Some of these species have a higher weight of indication than others. The term "species diversity" (D), which was introduced into ornithology by *Bezzel* and *Reichholf* (1974) and *Höser* (1976) is a good characteristic of the ecosystem-variety:

$$D = \sum_{i=1}^{s} \frac{Ni}{N} \ln \frac{Ni}{N} \cdot 1{,}44 \qquad (1)$$

The term of the rate of missing species (A) according to limnological research by *Kothe* (1962) with regard to ornithological research by *Kalbe* (1978) seems to be more fitting:

$$A = \frac{A_1 - A_x}{A_1} \cdot 100 \qquad (2)$$

Table XX/4.

Appendix: Weight of indication (i) by breeding waterfowl in

Black-throated Diver	2,0
Great Crested Grebe	1,0
Red-necked Grebe	1,25
Black-necked Grebe	1,5
Little Grebe	1,25
Cormorant	1,5
Heron	1,0
Little Bittern	1,5
Bittern	1,25
Mallard	1,0
Teal	1,5
Garganey	1,25
Gadwall	1,5
Pintail	2,0
Shoveler	1,5
Tufted Duck	1,25
Pochard	1,0
White-eyed Pochard	1,75
Goldeneye	1,75
Goosander	2,0
Grey-lag Goose	1,5
Mute swan	1,0
Mute Swan (Wildpopulation)	1,5
Lapwing	1,0
Little Ringed Plover	1,25
Snipe	1,5
Curlew	1,5
Black-tailed Godwit	1,75
Redshank	2,0
Common Sandpiper	1,75
Ruff	2,0
Common Gull	1,25
Black-headed Gull	1,0
Black Tern	1,25
Common Tern	1,5
Coot	1,0
Moorhen	1,25
Water Rail	1,0
Spotted Crake	1,25
Little Crake	1,75

Typical stock of breeding birds in natural areas of waterfowl

Clearwater shallow lake: ***Podiceps cristatus, griseigena nigricollis, ruficollis; Ixobrychus minutus; Botaurus stellaris; Anas platyrhynchus, crecca, querquedula, strepera, acuta; Spatula clypeata; Aythya ferina; nyroca; Anser anser; Cygnus olor; Larus ridibundus; Chlidonias niger; Fulica atra; Gallinula chloropus; Rallus aquaticus; Porzana porzana;***

Alcaline peatlands: ***Anas platyrhynchus, querquedula, acuta; Spatula clypeata; Anser anser; Vanellus vanellus; Gallinago gallinago; Numenius arquata; Limosa limosa; Tringa totanus; Philomachus pugnax;***

Oligotrophic lake: ***Gavia arctica; Podiceps cristatus; Anas platyrh.; Bucephala clangula; Mergus merganser; Cygnus olor; Fulica atra.***

So, we have the possibility to ascertain the causes of environmental change if we have obtained the stock of breeding birds through investigations over a long period of time. A high rate of missing species indicates essential changes of the environment. If we know the typical breeding stock of a natural water-ecosystem we can find out the actual theoretical rate of missing species (A_T). The result will give us the actual step of impoverishment of the ecosystem.

$$A_T = \frac{\sum(A_0 \cdot i) - \sum(A_x \cdot i)}{\sum(A_0 \cdot i)} \cdot 100 \quad (3)$$

A_0 is the theoretical stock of breeding species, i is the weight of indication from 1,0 to 2,0 (Appendix).

Firstly we must find out the typical breeding stock in all natural water-ecosystems. After calculating A_T in the second step we must formulate the aims of management and preservation.

In this case we are only at the beginning of our investigations. But I hope this will be a good possibility of preserving nature and with this preserving waterfowl too of course.

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XXI. *BRANTA BERNICLA* IN THE WADDEN SEA WITH SPECIAL REFERENCE TO THE NORTH FRISIAN SECTION (SCHLESWIG-HOLSTEIN)

P. Prokosch

Introduction

The Wadden Sea on the North Sea coast of Denmark, the Federal Republic of Germany and the Netherlands at certain times of the year holds up to 95% of the total population of *Branta bernicla bernicla* (*Ebbinge et al.*, 1981). The following abstract gives information about the phenology and distribution pattern in the Wadden Sea, the population development and how this affects the situation in Nordfriesland (Schleswig-Holstein).

Phenology and distribution pattern

Within the annual living range of *Branta b. bernicla*, the Wadden Sea area plays its most important role in spring and autumn (Fig. 1). While the distribution pattern in autumn (Fig. 2) reflects to a great extent the position of *Zostera* fields (mainly *Zostera noltii*) on the mudflats, the spring pattern depends essentially on the occurrence of saltings in the supralitoral zone (Fig. 3). Whereas in the northeast part of the Wadden Sea (Nordfriesland), we observe equal peak numbers in October and in April/May, there is a much less obvious autumn peak in the southwest (Dutch Wadden Sea) with only 30 – 40% of the April numbers. On the other hand we do find – apart from the main real wintering grounds in England and France – many more Brent Geese in the relatively warmer Netherlands (mean temperature in January around 4 °C) than in the colder Schleswig-Holstein area (0 – 1 °C) in midwinter (Fig. 4). In all parts of the Wadden Sea its function as the migration to the USSR (compare *Ebbinge et al.*) seems to be the most important to the geese.

For four years the IWRB – BRENT RESEARCH GROUP was able to organise, in addition to the international January population count, a second check of the total population by having a synchronised count in April or May in England, the Netherlands, the Federal Republic of Germany and Denmark. These counts proved that we were able to find in winter and spring, mostly with different teams of observers (due to the different distribution of the geese), more or less the same total population of *Branta b. bernicla*. The totals of these two checks each year varied from each other in a range of only ±10%.

It became obvious that about 95% of all Dark-bellied Brent Geese are present in the Wadden Sea during April/May and only about 10% in midwinter (e. g. Tab. 1). In April/May Brent Geese can be seen all over the Wadden Sea area. Still they do not disperse quite homogeneously. The highest

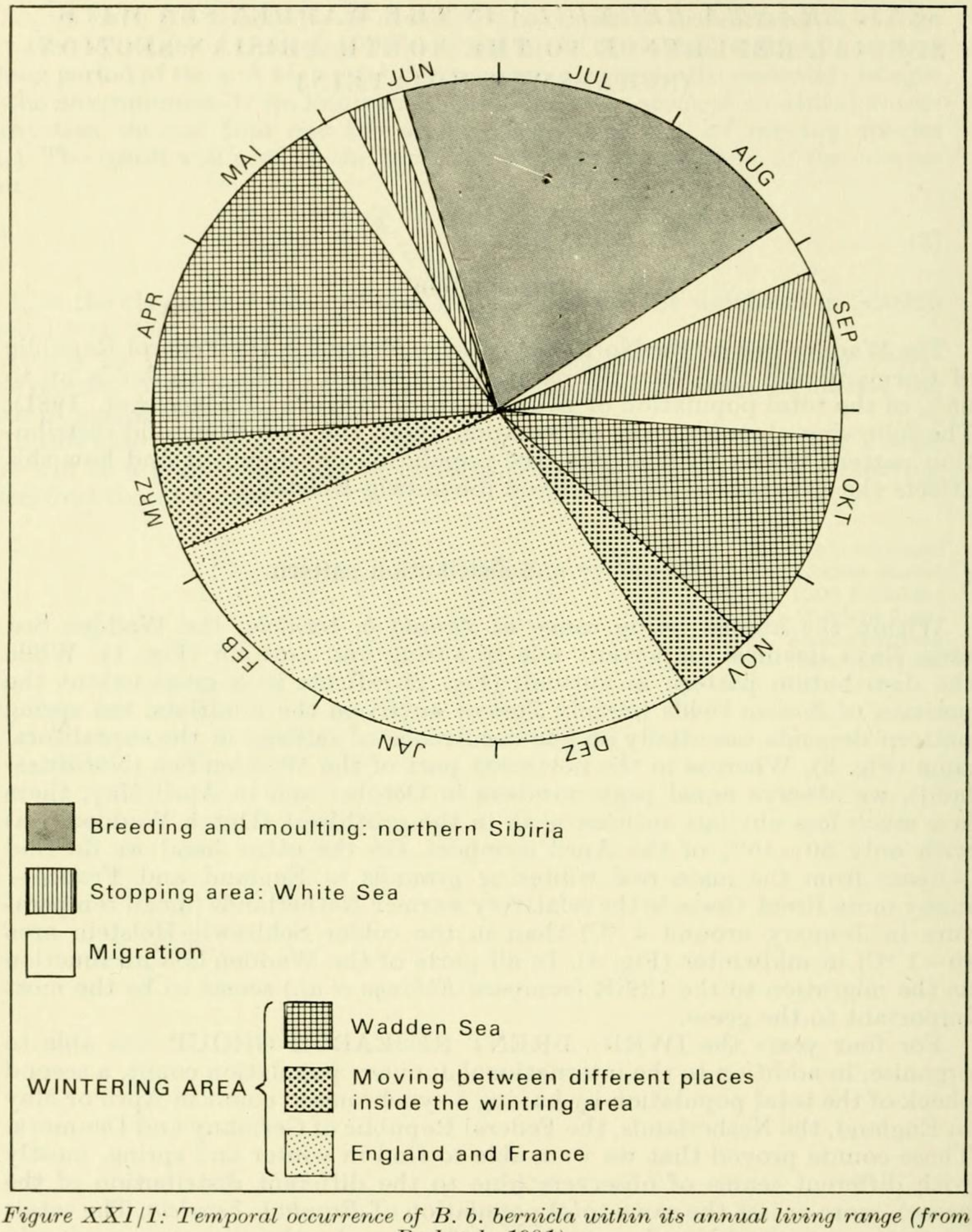

Figure XXI/1: Temporal occurrence of B. b. bernicla within its annual living range (from Prokosch, 1981)

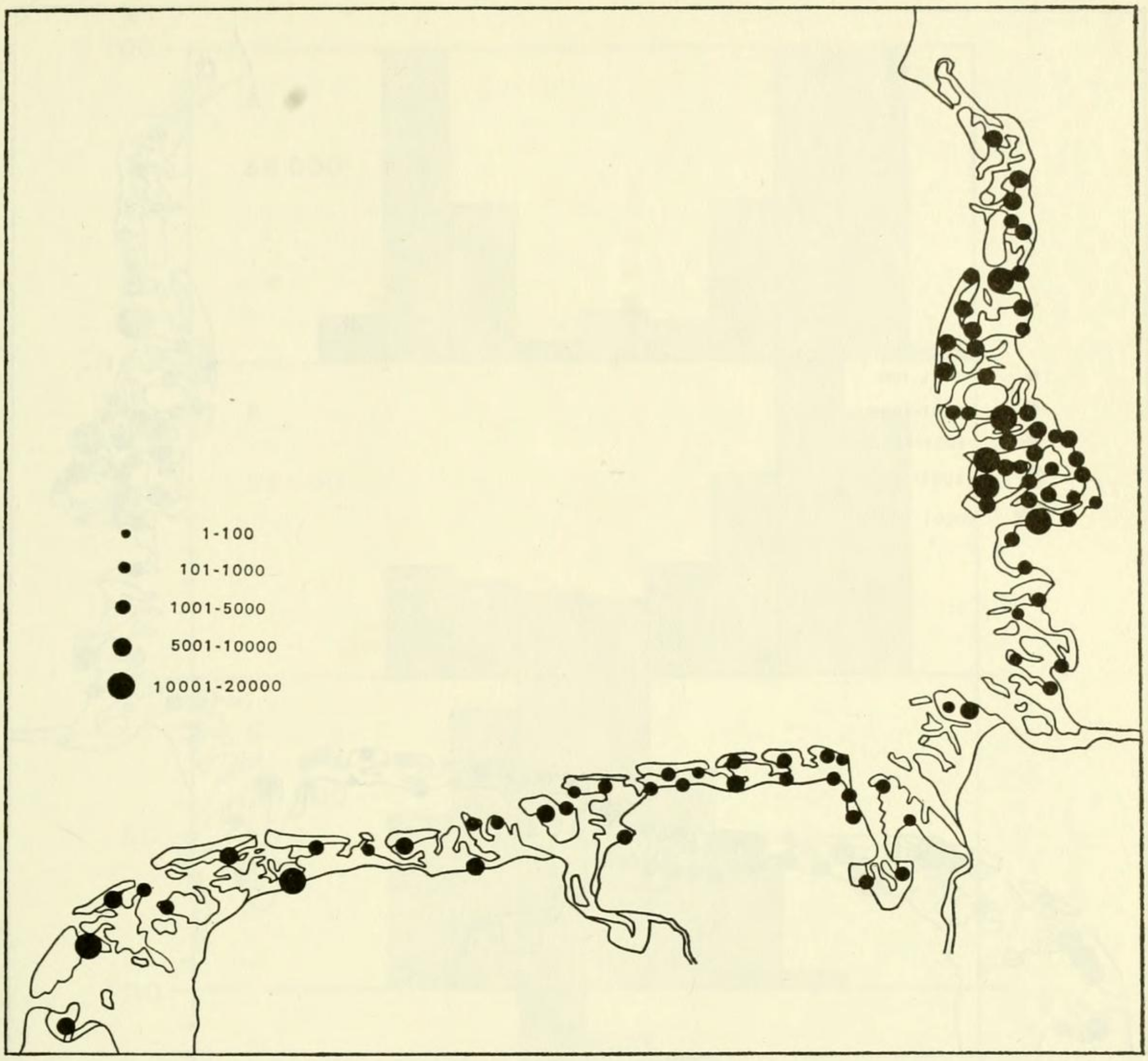

Figure XXI/2: Autumn (October) distribution of Brent Geese in the Wadden Sea (from Ebbinge et al. 1981)

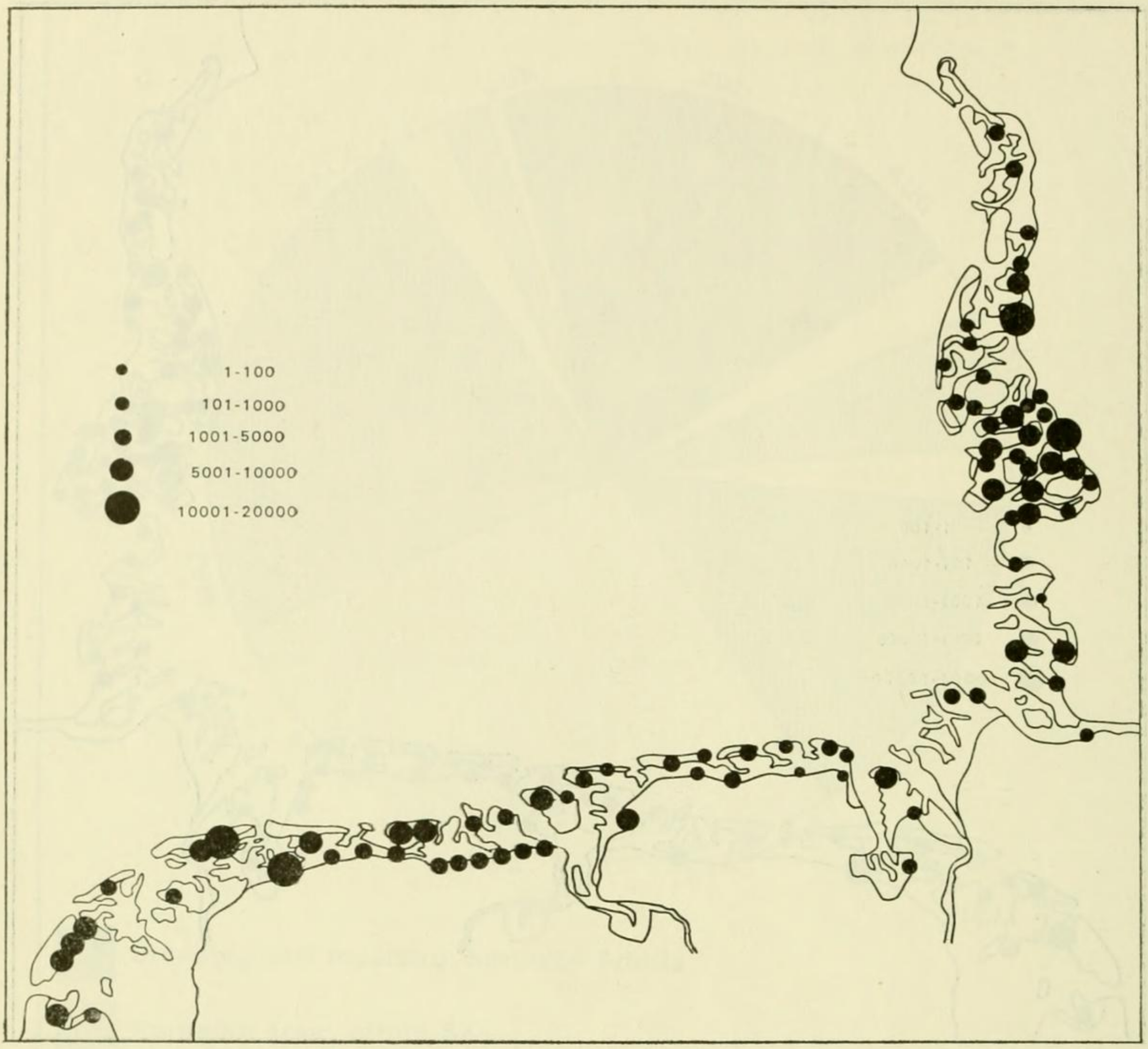

Figure XXI/3: Spring (April-May) distribution of Brent Geese in the Wadden Sea (from Ebbinge et al. 1981)

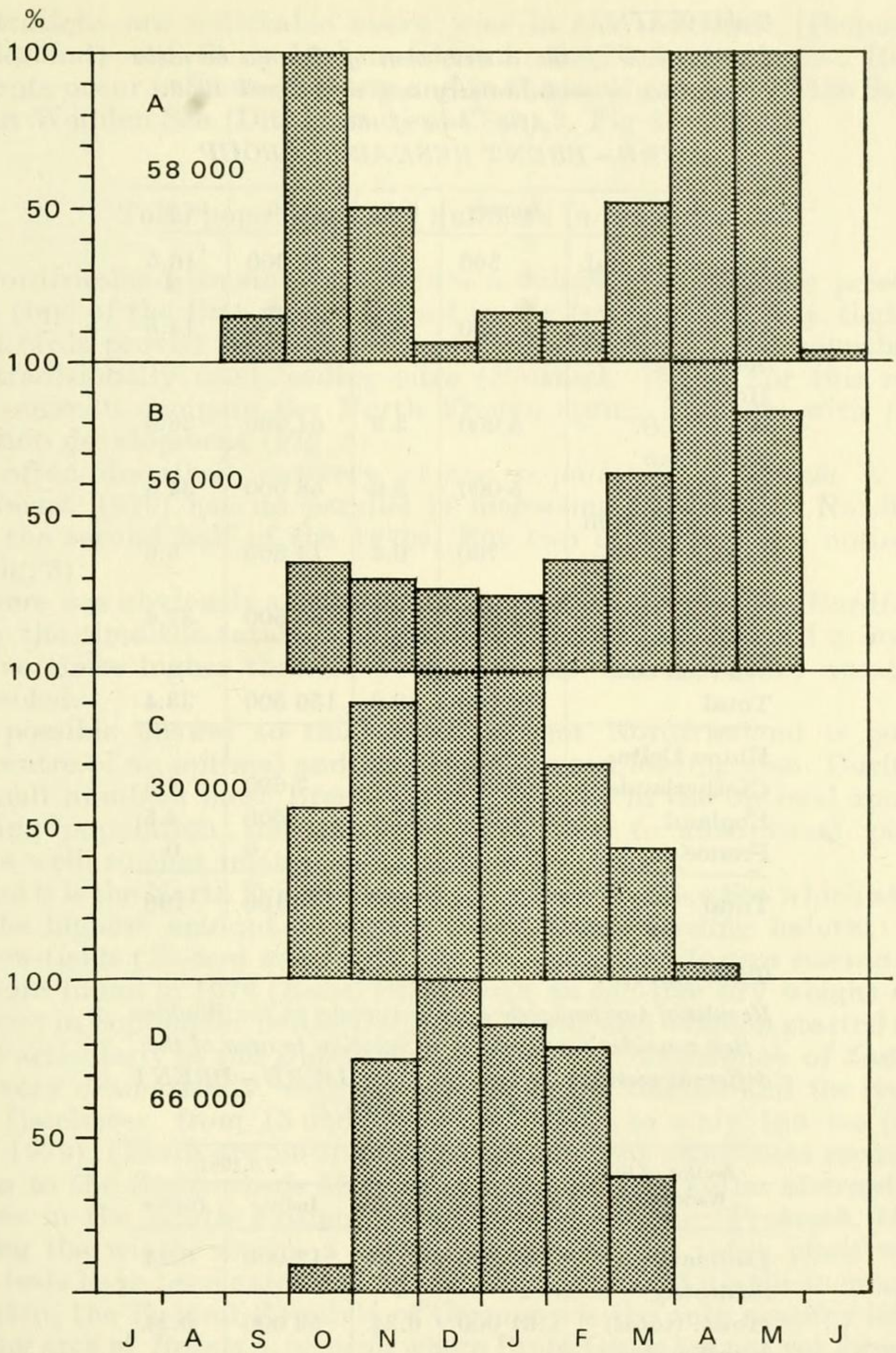

Figure XXI/4: Phenology of B. b. bernicla in 4 different parts of the wintering area: N. Frisian Wadden Sea (A: 1974–1978), Dutch Wadden Sea (B: 1974–1978). Essex (England) (C: 1974–75) and France (D: 1979–80, 1980–81). After Ebbinge et al. 1981, Maheo in litt. Prokosch 1981, St. Joseph 1979. (100% = the given maximum number)

Table XXI/1.

Comparison of the distribution of Branta bernicla bernicla in mid-January and mid-April 1980. After data of the IWRB – BRENT RESEARCH GROUP

	January	in %	April	in %
Denmark total	300	0.2	28 000	16.5
Danish Wadden Sea	300	0.2	24 500	14.5
Schleswig-Holstein Wadden S.	5 000	2.9	61 000	36.0
N. Frisian Wadden Sea	5 000	2.9	58 000	34.3
Wadden Sea in Lower Saxony	700	0.4	14 500	8.6
Dutch Wadden Sea	12 000	7.1	56 500	33.4
Wadden Sea Total	18 000	10.6	156 500	33.4
Rhine Delta (Netherlands)	10 500	6.2	7 600	4.5
England	81 000	47.8	1 500	4.5
France	60 000	35.3	0	0
Total	169 500	100	169 100	100

Table XXI/2.

Results of two complete spring surveys in the Wadden Sea considering numbers in relation to area of the different sections. After data of the IWRB – BRENT RESEARCH GROUP

Section of the Wadden Sea	20.4.1980		7.5.1981	
	Individuals	Ind/ha	Indiv.	Ind/ha
Denmark	24 500	0.49	12 000	0.24
Schleswig-Holst. (total)	61 000	0.24	59 000	0.24
Nordfriesland (part)	58 000	0.36	57 000	0.36
Dithmarschen (part)	3 000	0.03	2 000	0.02
Lower Saxony	14 500	0.07	15 000	0.08
Netherland	56 500	0.24	49 000	0.21
Total Wadden Sea	156 500	0.21	135 000	0.21

concentrations are noticeable every year in the northeast (Denmark and Nordfriesland) with fairly high numbers in the Netherlands too. Relatively few Brents occur in Lower Saxony and in the southern part of the Schleswig-Holstein Wadden Sea (Dithmarschen) (Tab. 2, Fig 3).

Total population and numbers in Nordfriesland

In Nordfriesland constant maximum numbers of Brents are present during the time of the first week of April to the last week of May. Sightings of marked birds proved that the same individuals stay for two months on the same, traditionally used feeding sites (*Prokosch*, 1981). For this reason it makes sense to compare the North Frisian spring numbers with the total population development (Fig. 5).

The often described recovery of the population of *Branta b. bernicla* (e. g. *Smart*, 1979) has its parallel in increasing numbers in Nordfriesland during the second half of the 1970s. But two differences are noticeable as well (Fig. 5):

1. There was obviously a delay in the increase of the geese in Nordfriesland.
2. By the time the total population in 1979/80 had reached a level more than five times higher than 15 years ago, the North-Frisian numbers had only trebled.

One possible answer to this could be that Nordfriesland is positioned in the centre of an optimal and traditionally used feeding area. During times with small numbers most Brents do concentrate in the optimal zone. With increasing population they have to distribute to suboptimal peripheral zones as well, so that relations of numbers do change.

Indeed it is the North Frisian part of the whole Wadden Sea which at present holds the highest amount of marine Brent Goose feeding habitat: 2600 ha of *Zostera*-fields *(Zostera noltii* with a small amount of *Zostera marina angustifolia)* were found in 1979 (*Reise*, 1979), with an ash-free dry weight of about 600 – 900 t in September before feeding of Brent and Wigeon started (*Schultz*, 1980). Particularly in the Dutch Wadden Sea the occurrence of *Zostera* decreased very dramatically, with the disease in the thirties and the reclaiming of the Ijsselmeer, from 15 000 ha (1920 – 1932) to only 160 ha (1972/83) (*Wolff*, 1979). (There are no indications of a recent significant recovery.) In addition to the *Zostera* beds 5500 ha of saltings (1981) offer alternative food resources in the North Frisian Wadden Sea in spring (*Prokosch*, 1981).

During the winter season a change of marine diet takes place when the *Zostera* beds have been eaten out by January (Fig 6). With the increase in the population, the Federal Republic of Germany is the only country left in the wintering area of *Branta b. bernicla* where Brent Geese are not yet forced to use terrestrial feeding sites in numbers worth mentioning. In Britain, France, the Netherlands and Denmark the capacity of the marine feeding resources have already been exceeded during the last years (s. different authors in *Smart*, 1979).

The expansion of the spring feeding area used in Nordfriesland between 1976 and 1981 is shown in Figs. 7 and 8. We have the impression that not until spring numbers reached 50 000 – 60 000 had the carrying capacity of the saltings been reached in this area. During the last three years, very locally, first inland feeding with up to 2000 birds in total has been observed.

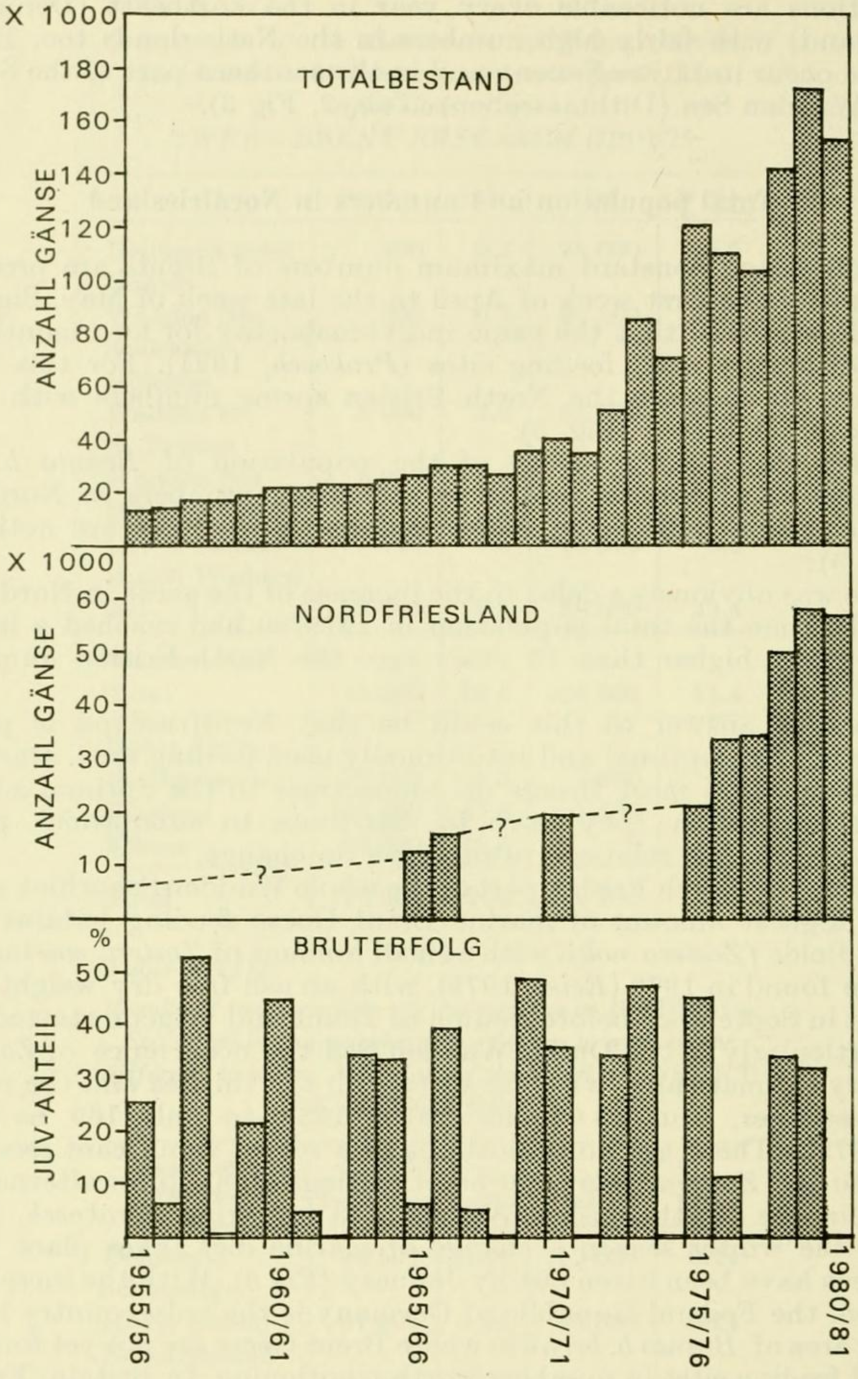

Figure XXI/5: Population development of B. bernicla during the period 1955/56 to 1980 (81 top), maximum spring numbers in the N. Frisian Wadden Sea (middle) and annual breeding success expressed as % of juveniles in the wintering flocks (bottom). From Prokosch 1981 after data of the IWRB Brent Research Group

Figure XXI/6: Phenology of B. b. bernicla in the N. Frisian Wadden Sea (1974 – 1978) with respect to changing diet. Stippled: feeding in the eulitoral zone (Zostera, Enteromorpha); hatched: feeding on the supralitoral saltings. From Prokosch, 1981

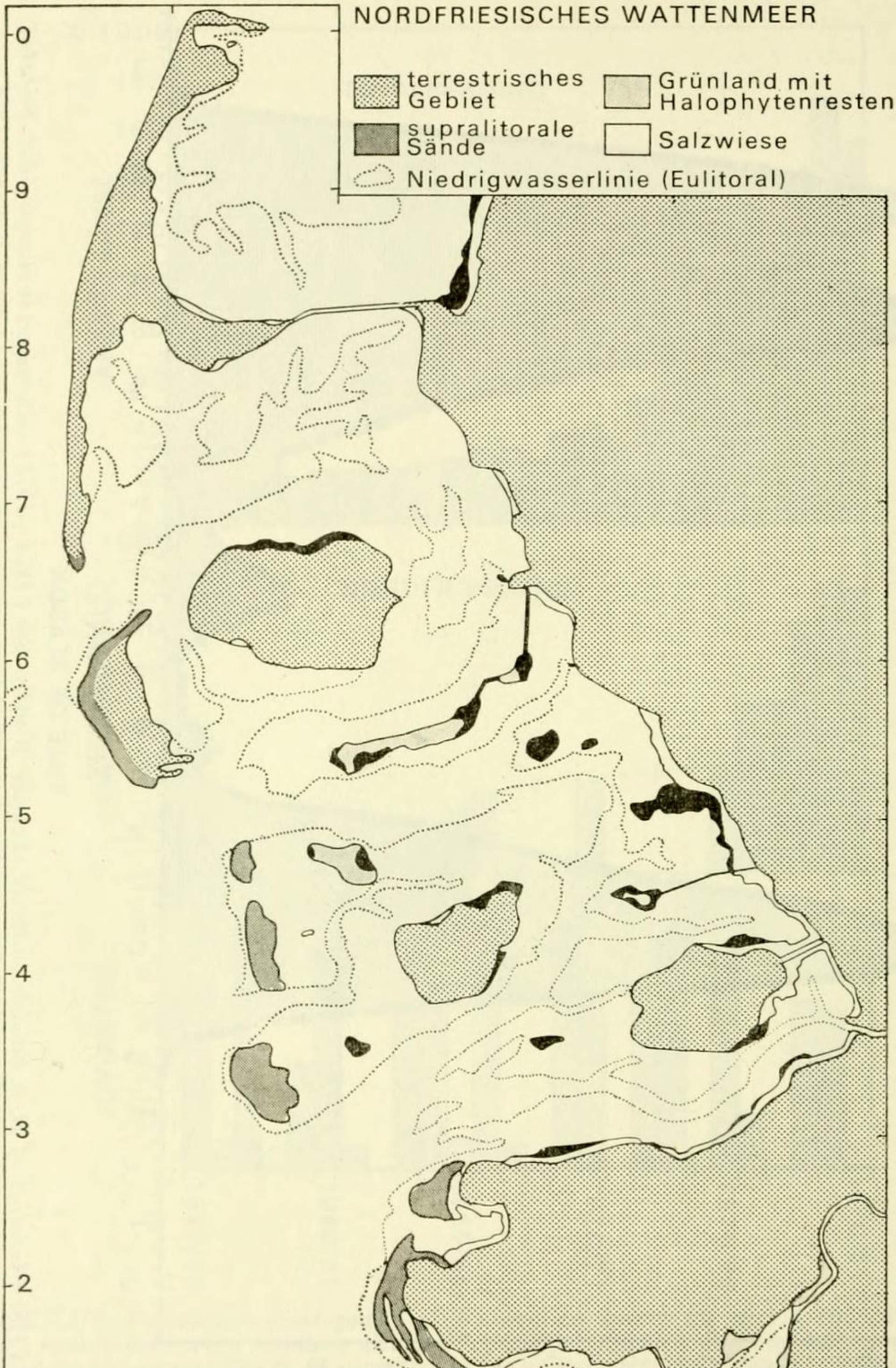

Figure XXI/7: Feeding areas (saltings) in the N. Frisian Wadden Sea used during spring 1976.

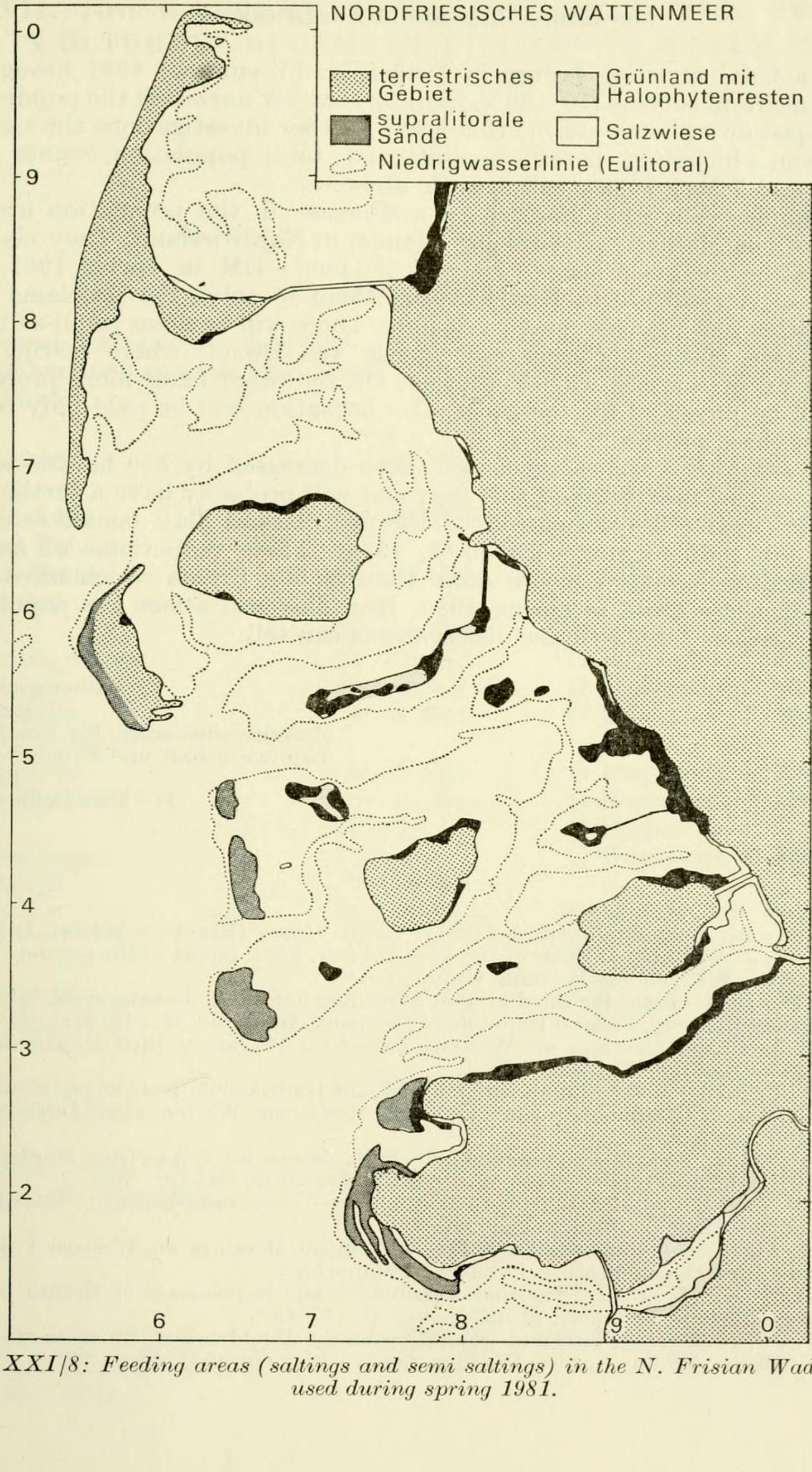

Figure XXI/8: Feeding areas (saltings and semi saltings) in the N. Frisian Wadden Sea used during spring 1981.

The future situation in Nordfriesland

After a total breeding failure in 1980 (Fig. 5), summer 1981 brought a small to medium success (10 – 20% juv.). It is as yet unclear if the population has dropped or will stay stabile this year. Further investigations throughout this season – including juvenile counts and total population counts on 9 January and 7 May 1982 – will provide answers.

The people who would like to see a decrease in the population are the farmers of the Halligen (flat salting islands) in Nordfriesland. They claimed compensation for grass losses of about 200 000,– DM in spring 1981. The Minister of Agriculture in Kiel has told them to solve the problems next spring with a new management programm. There will be areas (semi-saltings) on 3 private Halligen (Langeness, Hooge and Oland) where scaring and probably even shooting will be allowed. On the other hand more protected areas will be provided for the geese. Compensation will be paid only to the owners of these protected zones.

At the same time the saltings have been decreased by 550 ha due to the diking in of Rodenas-Vorland this year and will probably have a further loss of 845 ha with the reclamation of the Nordstrand Bay (small solution) planned for 1982 (compare *Prokosch*, 1979). These reductions of natural marine feeding habitat concern more than 20 000 Brents which have been counted in these areas in spring 1980. How this will affect the population (and the farmers?) only future observations can tell.

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XXII. GOOSE OBSERVATIONS IN THE PANNONIC REGION IN OCTOBER–DECEMBER 1980 AND IN MARCH 1981

T. Lebret

Introduction

Several teams counted geese in the Pannonic region between October and December 1980 and one team was there in March 1981. The areas visited were as follows:

Site	*Date(s)*	*Observers*
Kopaci rit	19–23 Oct	T Lebret, Dr J Mikuska, G L Ouweneel
Kardoskút Szeged Fehértó	24–25 Oct	T Lebret, G L Ouweneel
Neusiedlersee Seewinkel	26–27 Oct	T Lebret, G L Ouweneel
Tata	23–24 Oct	G Huyskens, P Maes
Hortobágy area	24–28 Oct	G Huyskens, P Maes
Biharugra	29 Oct–1 Nov	G Huyskens, P Maes
Kardoskút Szeged Fehértó	2–4 Nov	G Huyskens, P Maes
Velencei-tó	6–7 Nov	G Huyskens, P Maes
Balaton area	9–10 Nov	G Huyskens, P Maes
Tata	11 Nov	G Huyskens, P Maes
Neusiedlersee Seewinkel	12 Nov	G Huyskens, P Maes
Tata	20–24 Nov	LMJ van den Bergh, JNF van den Bergh–van Leeuwen, D Visser
Danube Valley (East Bank)	25–27 Nov	LMJ van den Bergh, JFN van den Bergh–van Leeuwen, D Visser
Kardoskút Szeged-Fehértó	28 Nov	LMJ van den Bergh, JFN van den Bergh–van Leeuwen, D Visser
Balaton + two other areas in W. Hungary	2 Dec	LMJ van den Bergh, JFN van den Bergh–van Leeuwen, D Visser
Tata	28 Feb–6 Mar	LMJ van den Bergh, J Philippona, E C Smith and D Visser
The Danube Valley, Balaton, Kardoskút and Hortobágy	were briefly visited in spring but no geese were found	

The autumn observation period lasted 45 days, the spring period 7 days. Some areas were visited several times: Tata 23 – 24 October, 11 November, 20 – 24 November, 28 February to 6 March; Kardoskút 24 – 25 October, 2 November; Seewinkel 26 – 27 October, 12 November.

Van den Bergh et al. are preparing a special paper on several aspects of the biology of the Tata geese and the very intensive shooting in that area. Huyskens paid special attention to the *Anser fabalis* races. The present report is a compilation of three reports by van den Bergh et al., a report by Huyskens and the authors.

Methods

Geese are easily overlooked when they are feeding in extensive fields with much cover, especially when the days are short, visibility is bad and the observer unfamiliar with the sites. Reliable counts are for the greater part made near the roosts. As the geese may sometimes arrive in almost complete darkness, counts during the morning flight are preferable. A wide scale of weather types may favour or hamper the observations.

There was a full moon on 23 October and on 22 November. Flocks of the order of 300 birds are not mentioned here in the csae of the commoner species. Numbers of *Anser erythropus* and *Branta ruficollis* are complete.

Areas

Kopaci rit is a marsh of some 30 000 ha at the confluence of the Drava and Danube. The higher ridges are wood covered but there are many often extensive "jezeros", lakes and oxbows.

Kardoskút – Fehértó: puszta reserve with a very shallow soda lake (fehér means white and tó pond or lake). The name Fehértó is common all over Hungary. It is also Hungarian for Lake Neusiedl. Kardoskút is to the ENE of Hódmezővásárhely.

Szeged – Fehértó: fish ponds and salt lake some 10 km north of Szeged.

Hortobágy area: the well known large-scale plain with large fish ponds.

Virágoskút: a fish pond in the NE of this region.

Biharugra: fish ponds on the Hungarian – Rumanian border near Komádi.

Velencei-tó: near Székesfehérvár ± marsh near Dinnyés railway station.

Balaton

Tata: the roost is on Öreg-tó, to the SE and bordering the town of Tata.

Danuble Valley (East bank): Szabadszállás, Hajós – Dusnok and region south of Baja.

West Hungary: Region near Nagyatád and Balaton.

Results

Kopaci rit	21 Oct morning flight	21 500	*Anser fabalis*
	23 Oct morning flight	20 550	*Anser fabalis*
Road Hódmezővásárhely-Kardoskút	1600 hours evening flight of some	3000	*Anser albifrons*

These birds were flying parallel to road to the southwest, obviously towards Szeged-Fehértó and not to nearby Kardoskút, probably due to the lack of water at the latter locality.

Kardoskút	24 October	9 000	*Anser albifrons*
		4	*Anser erythropus*
		3	*Branta ruficollis*
Lange Lacke, Seewinkel	26 October	23 750	*Anser fabalis*
		4 000	*Anser anser*

Huyskens & *Maes* in their report pay much attention to the race of the *Anser fabalis* observed, stating that these geese all belonged to the race *A. f. rossicus;* no flocks of mixed composition occurred.

Tata	23 October	8 000	*Anser fabalis*
Hortobágy fishpond	23 October	10 000	*Anser albifrons*
		70	*Anser erythropus*
Virágoskút fishpond	26 October	4 000	*Anser albifrons*
		300	*Anser anser*
		100	*Anser fabalis*
Hortobágy and west to Tiszafüred	28 October	1 500	*Anser albifrons*
		50	*Anser fabalis*
		10	*Anser erythropus*
		20	*Anser anser*
Total in Hortobágy area 20 000 *Anser albifrons* is well possible	25 – 28 October	15 000	*Anser albifrons*
		1 200	*Anser anser*
		150	*Anser fabalis*
		80	*Anser erythropus*
Biharugra southern ponds	29 October	1 500	*Anser albifrons*
		20	*Anser fabalis*
Biharugra northern ponds	30 October	4 500	*Anser albifrons*
		750	*Anser anser*
		300	*Anser fabalis*
Kardoskút	31 October	20 000	*Anser albifrons*
		300	*Anser fabalis*
		100	*Anser anser*
		30	*Anser erythropus*
		11	*Branta ruficollis*
Szeged-Fehértó from E (evening flight)	2 November	11 000	*Anser albifrons*
		2 500	*Anser fabalis* (local information)
Szeged-Fehértó snow	3 November	30 000	*Anser albifrons*
Csaj-tó (W of Szentes) (evening flight)	4 November	500	*Anser albifrons*
		500	*Anser anser*

Velencei-tó	6 November	30 000	*Anser fabalis*
Velencei-tó	7 November	30 000	*Anser fabalis*
(evening flight)		1 000	*Anser albifrons*
		1 000	*Anser anser*
Balaton, SW (in fields) (evening flight) 5000 to Balaton, 1000 to Kis-Balaton	8 November	6 000	*Anser fabalis*
Balatonfenyves (evening flight)	9 November	20 000	*Anser fabalis*
Fields South of Siófok	11 November	550	*Anser fabalis*
Local information suggests		4 500	*Anser fabalis*
Total in Balaton region then might be		30 000	*Anser fabalis*
Tata (evening flight)	11 November	35 000	*Anser fabalis*
Lange Lacke – Seewinkel	12 – 13 November	22 000	*Anser fabalis*
(evening flight)		3 000	*Anser albifrons*
Tata	20 – 24 November	14 000	*Anser fabalis*
(counts at roost)		27 000	*Anser fabalis* (maxim.)
		1 000	*Anser albifrons*

Much variation in numbers due to full moon.

Distance to feeding places 10 – 30 km, in majority of cases feeding on corn fields with high stubble.

Hajós-Dusnok	25 November	1	*Branta ruficollis*
Dusnok		1 100	*Anser fabalis*
Nearby roost (West of Danube)		2 100	*Anser fabalis*
		4 700	*Anser fabalis*
Roost west of Szabadszállás	26 November	660	*Anser fabalis*
		155	*Anser anser*
		110	*Anser albifrons*
Danube Valley south of Baja	27 November	550	*Anser fabalis*
Szeged-Fehértó (morning flight)	28 November	16 000	*Anser albifrons*
Kardoskút (evening flight)		26 500	*Anser albifrons*
		175	*Anser fabalis*
		57	*Anser anser*
Nagyatád region	1 December	940	*Anser fabalis*
Balatonberény (roosts on ice)	2 December	5 000	*Anser fabalis*
Counts in spring			
Tata Öreg-tó (evening flight)	28 February	40 000	*Anser fabalis*
Tata (morning flight)	2 March	50 000	*Anser fabalis*
Tata (morning flight)	5 March	43 500	*Anser fabalis*
Kocs-Nagyigmánd (evening flight)	5 March	10 000	*Anser fabalis*

One more roost was found west of Komárom and a third near Kocs-Nagy-igmánd some 14 km to the west of Tata. On 6 March a neck-banded *Anser fabalis* was observed at the main roost of Öreg-tó and a few hours later near Kocs-Nagyigmánd. Changes from one roost to another may be made frequently.

12 *Anser fabalis* were observed with neckbands fitted in the German Democratic Republic. Van den Bergh had seen three of them before in the Netherlands-Niederrhein. One of these (B 83) had been observed near Salmorth (Niederrhein) on 18 December 1980 and was seen again near Kocs-Nagy-igmánd on 6 March 1981.

Tata appears to have far higher numbers during spring passage (over 50 000) than it has in autumn (35 000). This is conceivable as no geese were found in between 28 February and 6 March in the Balaton area and along the Danube south of Budapest. This might indicate that the Tata region is most favourable of the geese in spring, but it may also be less attractive in autumn due to the very intensive disturbance by shooting. Velencei-tó was not visited in March 1981.

Neusiedlersee	7 March	16 000 to 18 000 *A. fabalis*
Seewinkel		3 500 *A. albifrons*
		2 500 *A. anser*

Total by species in autumn 1980	
Anser fabalis	150 900
Anser albifrons	72 250
Anser anser	7 550

No doubt these counts do not give a true picture of the numbers present. In some areas only a proportion of the geese may have been found. In some cases a proportion may have been counted twice. The most important source of error seems that it is unlikely that the visit of the counting teams to a certain area coincided with the maximum number of geese in that area. The Kopaci rit for instance may have 50 000 *Anser fabalis* in November (*J. Mikuska* pers. com.). This is some 30 000 more than the number found there in the end of October but these 30 000 birds may have been counted somewhere in Hungary.

Moreover Kardoskút had a maximum of some 80 000 *Anser albifrons* from 10 – 13 November 1980 when there were 52 *Branta ruficollis (Sterbetz* in litt.). These figures are much higher than those of van den Bergh et al. near the end of the month, even if the Kardoskút count and that of Szeged-Fehértó are combined.

It seems very worthwhile to continue this type of observation in future years, if possible with better coordination.

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XXIII. PEAK NUMBERS OF GEESE AND CRANES ON AUTUMN MIGRATION IN THE KARDOSKÚT NATURE RESERVE, SOUTHEAST HUNGARY

I. Sterbetz

In Hungary, migration of geese and cranes depends heavily on weather and food conditions. This causes fluctuations in the course of migration and makes quantitative estimates difficult. Both IWRB monthly counts (*Sterbetz,* 1977) and counts made on successive days (*Lebret et al.,* in press) profide results wich occasionally are not of universal validity. If we wish to get a more exact trend, we should evaluate the peak counts over a longer time scale.

Here I present peak counts over 30 years at the Kardoskút Nature Reserve (46°30′N; 20°28′E). I consider the peak numbers taken from the autumn period (September – December) to be characteristic of the area. No similar evaluation is possible from spring migration wich is too concentrated in time.

70% of geese and all cranes migrating through Hungary will appear in the eastern part of the country, the steppe zone. Here one can find saline steppe patches, natron lakes and, more recently, fish pond systems which attract migrating birds. Large-scale maize farming provides a rich food source by split corp which is another factor attracting birds (*Sterbetz,* 1975, 1979/a, 1979/b).

During the last 20 years, the Kardoskút Nature Reserve has been the most important gathering site for geese and cranes in Hungary. The largest numbers were observed here. Birds on their way to the Balkans gather here and stay till the winter forces them to leave form ore southerly winter quarters. This peak reflects optimal habitat conditions for these birds. The recent increase after 1970 reflects the rich food source provided by the growing acre ages of large-scale maize farming.

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Table XXIII/1.

Peak numbers of geese and cranes

Year	*A. anser*	*A. fabalis*	*A. albifrons*	*A. erythropus*	*B. ruficollis*	*G. grus*
1951	22	1200	9 000	3 400		450
1952	–	3200	11 000	812		311
1953	12	1500	10 000	240		400
1954	3	3000	12 000	500		1 200
1955	35	1200	18 000	11 000		800
1956	6	4500	11 000	300		500
1957	49	3300	16 000	140		900
1958	2	650	22 000	42		650
1959	14	1400	15 000	14		1 000
1960	150	1200	10 000	8		2 000
1961	61	800	14 000	150		1 500
1962	20	1100	25 000	2 000		800
1963	12	850	19 000	1 200		1 300
1964	4	2000	20 000	120		2 000
1965	38	2000	15 000	560		1 300
1966	120	4000	30 000	2 000	5	1 226
1967	50	6000	20 000	1 035		508
1968	1	4000	20 000	49		560
1969	23	8000	15 000	3 000		2 000
1970	–	3000	50 000	2 000	11	1 800
1971	42	6000	25 000	2 000		1 800
1972	8	2000	45 000	5 000	1	2 067
1973	–	1000	50 000	1 000		750
1974	–	88	70 000	2 000	10	4 000
1975	140	2000	10 000	500		5 000
1976	–	150	40 000	300		10 000
1977	48	39	30 000	150		10 000
1978	20	140	35 000	1 250	41	3 000
1979	250	119	60 000	1 300	15	8 000
1980	36	1500	80 000	22	52	4 000

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XXIV. GEESE IN YUGOSLAVIA

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Introduction

Obvious decreasing in number of all wild goose species in Middle and Southern Europa is also noted in the area of Yugoslavia. This fact points at the necessity of details research on ecology of these imperilled species if we want to protect them successfully.

Methods

This contribution is made according to author's own researches and literature data. Since all the literature refering to this area was not available to the author, it is possible that all founds of rare goose species are not included here.

Results and discussion

Till now eight wild goose species are noted on the territory of Yugoslavia: Barnacle Goose [*Branta leucopsis* (*Bechstein*, 1803)], Brent Goose [*Branta bernicla* (L., 1758)], Red-breasted Goose [*Branta ruficollis* (*Pallas*, 1769)], Greylag Goose [*Anser anser* (L., 1758)], White-fronted Goose [*Anser albifrons* (*Scopoli*, 1769)], Lesser White-fronted Goose [*Anser erythropus* (L., 1758)], Bean Goose [*Anser fabalis* (*Latham*, 1787)] and Pink-footed Goose [*Anser brachyrhynchus* (*Ballion*, 1833)]. Other species, such as Bar-headed Goose [*Anser indicus* (*Latham*, 1790)] and Snow Goose [*Anser caerulescens* (L., 1758)] have not yet been observed.

Barnacle Goose [*Branta leucopsis* (*Bechstein*, 1803)] is rarity in Yugoslavia. Till now, only one specimen is known, shot in November 1953 at Lukino Selo (9), Banat, northeastern Yugoslavia (*Csornai*, 1957). *Landbek* (1842) has noted it for Srem (8), but without other data (Figure 1).

Brent Goose [*Branta bernicla* (L., 1758)] is also a rare bird. It is evidenced with certainly on three localities, on the River Cetina (1), where was caught on the 7th January 1899 (*Rossler*, 1902), at Lonjsko Polje (2) where was shot on the 23rd December 1906 (*Rucner*, 1970) and at Uzdin (3), where was found on the 15th October 1979 (*Dević*, 1980). According to *Csernel* (1899) this bird was caught in winter 1845/46 in the surroundings of Novi Sad (7), but without arguments. With certainty it was seen on the 16th December 1933, near Beograd (4) (*Matvejev*, 1950) and on the 13th January 1958 on Ludas Lake (5) (*Mikuska*, 1968). Except these findings, *Landbek* (1842) noted the Brent Goose for Srem (10), *Kolumbatović* (1880–1904) for Dalmatia and *Reiser*

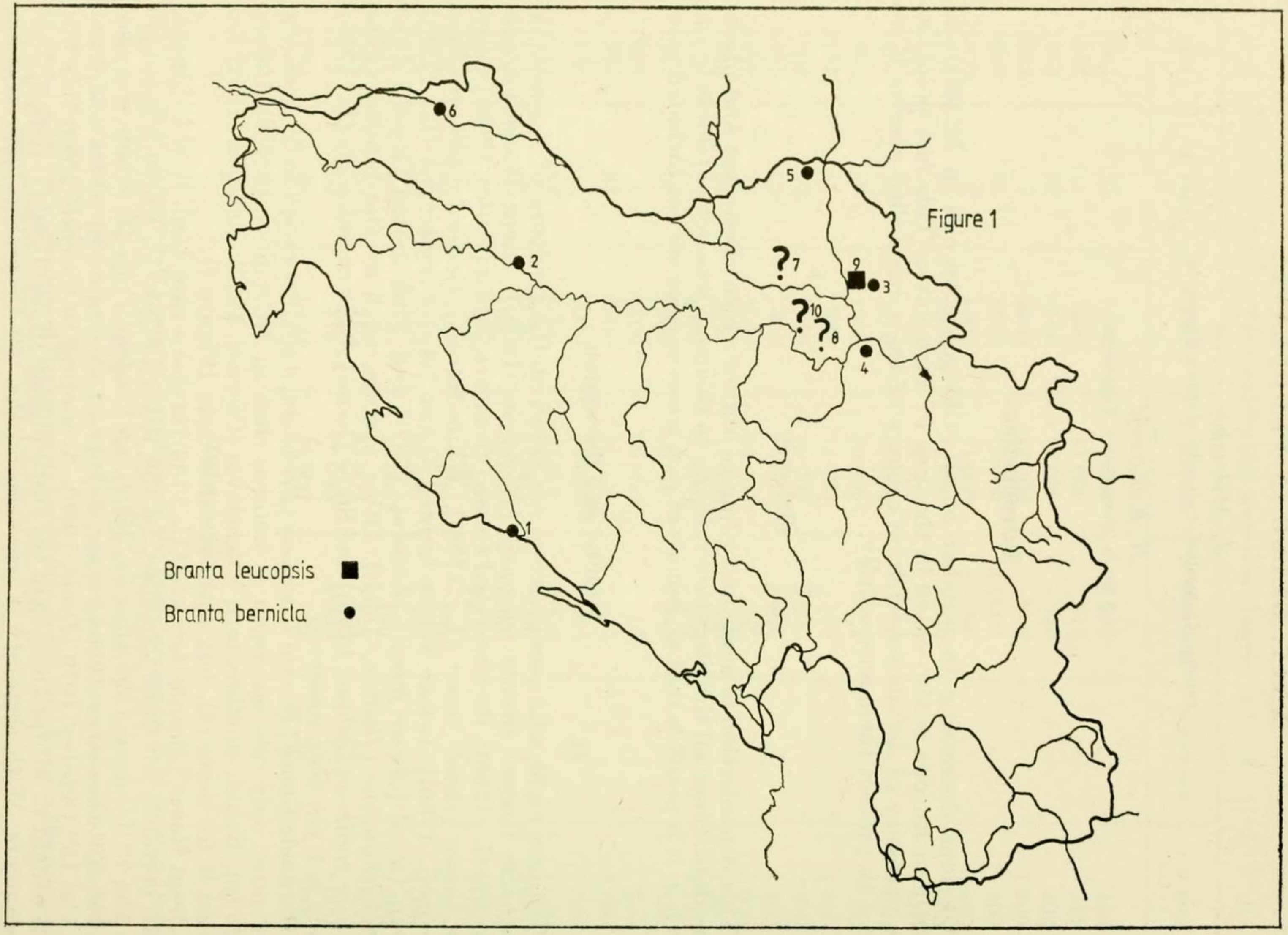

Figure XXIV/1: Branta leucopsis – Branta bernicla

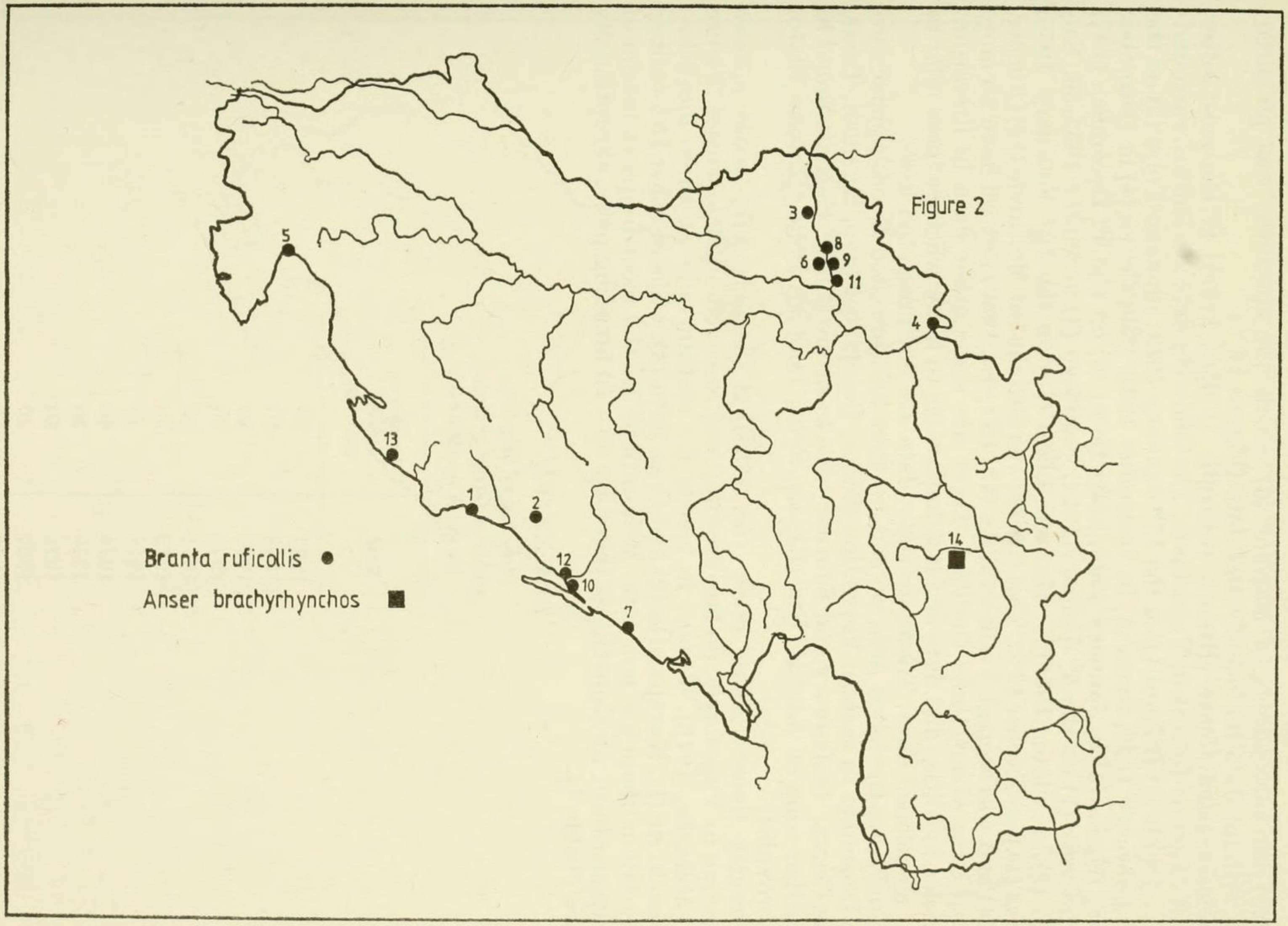

Figure XXIV/2: Branta ruficollis – Anser brachyrhynchus

(1925) for surroudings of Maribor (6) where one specimen was prepared, but without data on locality and date (Figure 1).

Red-breasted Goose [Branta ruficollis (*Pallas*, 1769)] is the most often guest of genus Branta in Yugoslavia. The following data are known: surroundings of Split (1) (Figure 1) on the 17th January 1929, Imotsko Polje (2) on the 28th February 1929, Senta (3) in December 1938, Bela Crkva (4) in December 1938, Rijeka (5) in January 1940, Stari Bečej (6) on the 9th December 1947, Dubrovnik (7) on the 6th January 1954, Stojičevo (8) in winter 1955/56, Kuman (9) in winter 1955/56, Hutovo Blato (10) on the 10th February 1956, Taras (11) in October 1962. This species was also shot at Metković (12) (*Rucner*, 1954) and was seen at Vransko Lake (13) (*Krpan*, 1980) but we have no more detail data about these findings. There are some other data in literature, without localities and date and it is impossible to know whether these refer to still mentioned data. Therefore those data are not presented here.

Analysing the listed data we can see that Red-breasted Goose appear during December in eastern Vojvodina (Senta, Bečej, Stojičevo, Kuzman, Taraš, Bela Crkva). In January and February due to severe winter, they are found in coastline zone of Adriatic See (Rijeka, Split, Imotsko Polje, Hutovo Blato, Dubrovnik).

Greylag Goose [*Anser anser* (L., 1758)] is the only wild goose species breeding in Yugoslavia. So far, breeding was recorded on 28 localities (Figure 3) (*Mikuska*, 1973). Today, it breeds for certain only at three localities: Kopački rit (1), Karapandža (2) and Crna Bara (3), while at other 15 localities they fail or there are not data. Meliorations are the most frequent reason of disappearance. At Kopački rit there are 20 – 40 breeding pairs, exceptionally more (Table 1).

Table XXIV/1.

Number of breeding pairs of Greylag Goose in the Kopački rit

Year	Number of breeding pairs cca
1967	30
1968	20
1969	20
1970	30
1971	40
1972	30
1973	30
1974	40
1975	30
1976	20
1977	30
1978	30
1979	20
1980	30
1981	100

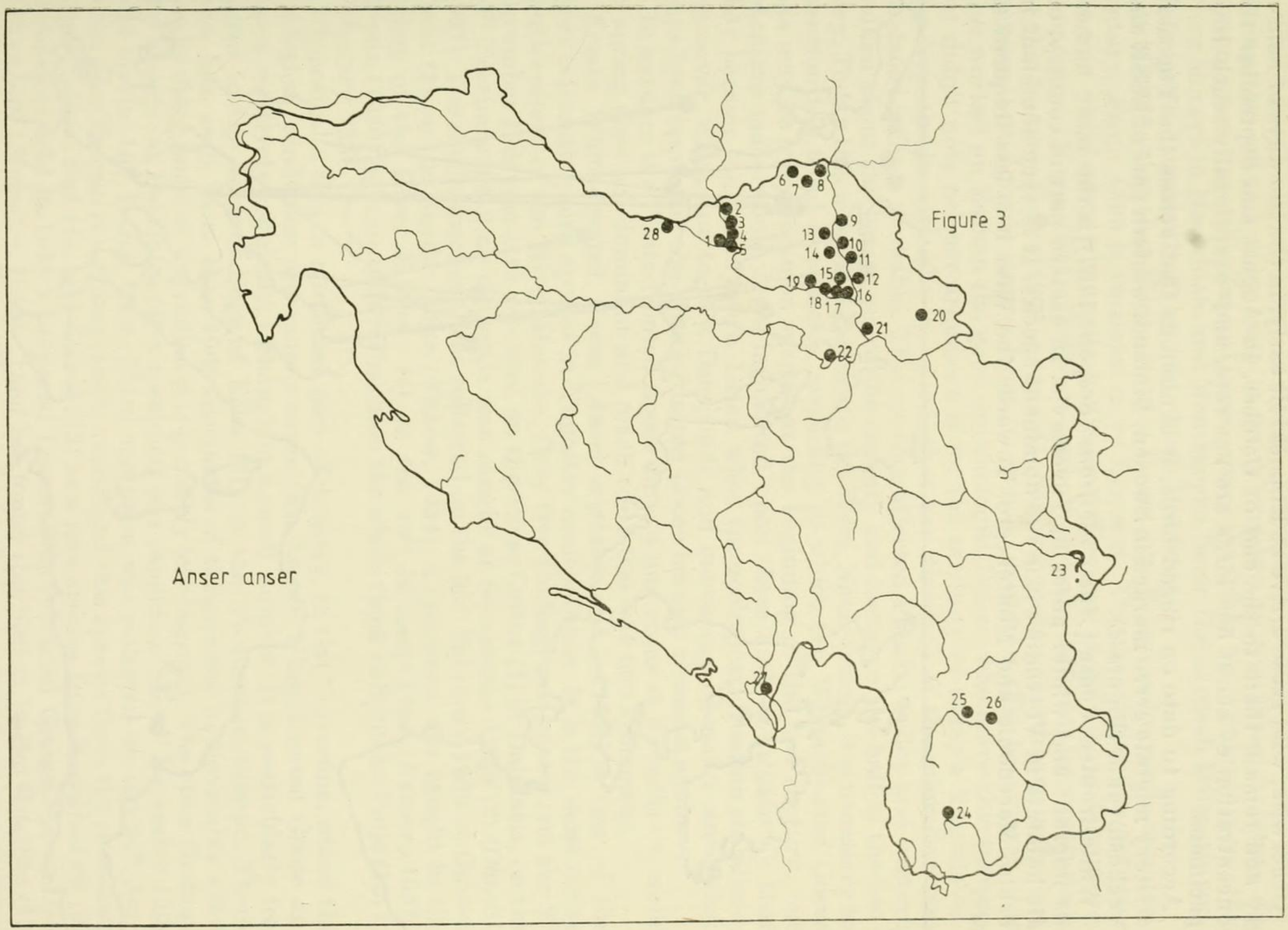

Figure XXIV/3: Anser anser

Otherwise, wild geese arrive at Kopački rit early, in the last days of February and remain there to the end of October. In August and September the concentration of about 500 birds are not rare, and exeptionally reach 1000 specimens.

According to date on ringed birds, it is obvious that across the Yugoslav territory migrate geese marked in Sweden, Finland, western part of USSR and Czechoslovakia (Figure 4).

White-fronted Goose [*Anser albifrons* (*Scopoli*, 1767)] is the most numerous migrant and winter guest in Yugoslavia. In eastern part of country, on salt habitats in Vojvodina it is the dominant species. It is very abundant in Serbia, Macedonia and Montenegro. Towards the West it is less frequent or rare.

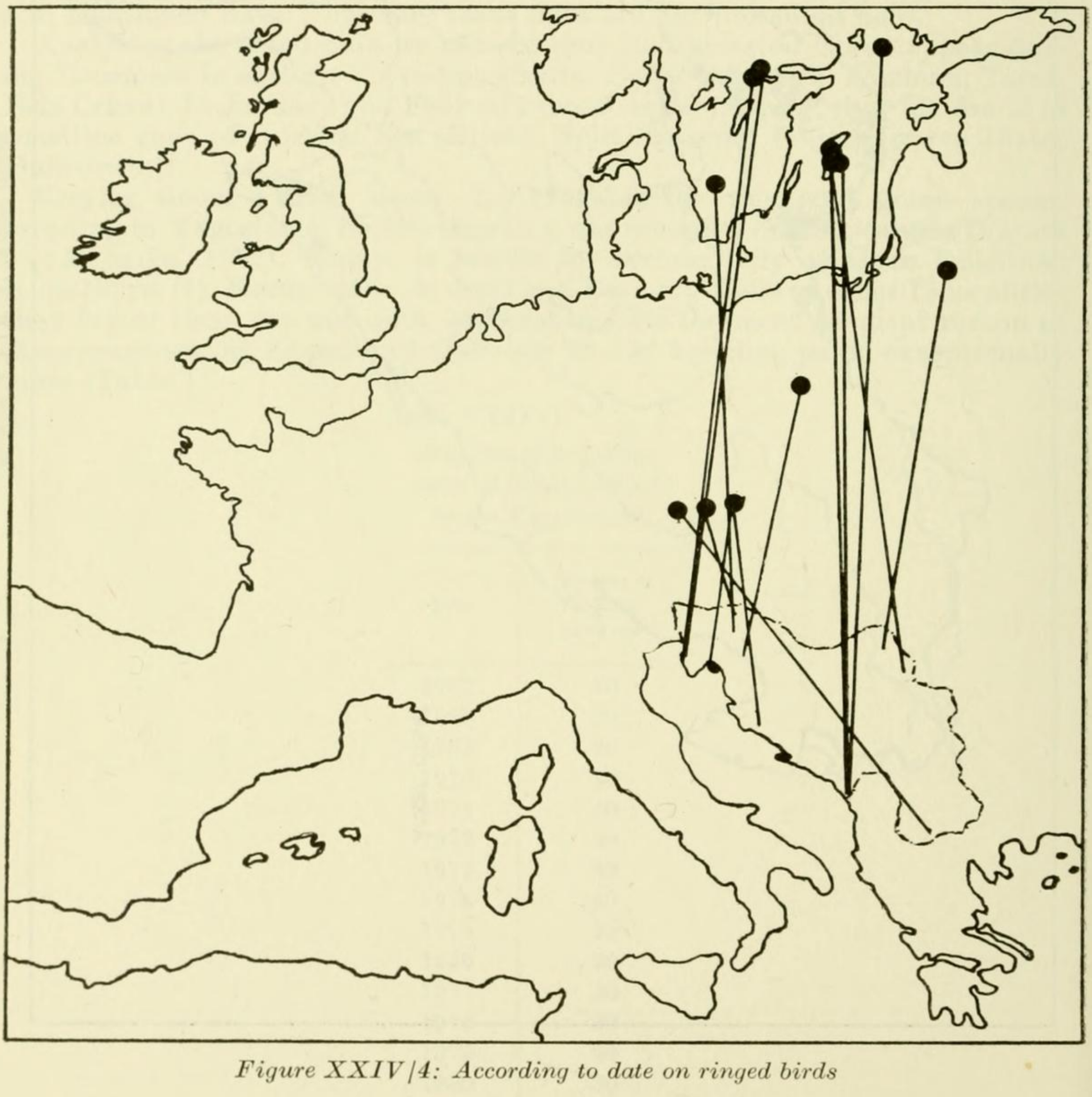

Figure XXIV/4: According to date on ringed birds

White-fronted Geese arrive in Banat, Yugoslavia, at the end of September. During the autumn they lasts in great number on the salted habitats. In winter, when water freezes and snow cowers the fields, they migrate along the River Morava in Macedonia and Montenegro. Some flocks reach Dalmatia too. They leave Yugoslavia in spring, about March.

It is interesting that White-fronted Goose was almost unknown here in last century. From 1899 it becomes more frequent. The maximum was between the two world-wars when only in Panon valley was more than million geese in one year (*Nagy*, 1924). Different authors give the different interpretations for this feature. *Vertse* (1967) supposed that this goose was ordinary in the last century, but nobody argumented it. Others doubt in this because at this time worked on Balkan the good ornithologist *Reiser*, who know this species, but didn't note neither argument it for the territory of today's Yugoslavia. The hypothesis, officially accepted, that the direction of the migration was displaced is more probable. This moving affected Pannon valley and western Balkan about the beginning of the century and lasted to the half of the century. Today this moving is farther to the West. Nevertheless, it is necessary to mention the third hypothesis, according to which the White-fronted Goose was may be very common species at the beginning of the last century, but intensive meliorations have influenced upon these birds so negatively that they became temporarly rare. Later, when the ecological situation stabilized, moreover, when due to new fish-ponds and increasing of water areas that have been improved the White-fronted Goose become common again.

In autumn the White-fronted Goose are not numerous at Kopački rit, while in spring they are dominant and reach to 10 000 – 18 000 specimens.

Lesser White-fronted Goose [*Anser erythropus* (L., 1758)] is one of the most interesting bird species in Yugoslav ornithofauna. It is the most rarity southwestern of the River Danube. Only five findings are known: on the 2nd December 1905 one bird was shot on the River Cetina (1) in Dalmatia, on the 11th February 1912 an old male was caught at Sarajevsko Polje (2) (*Obratil*, 1967). The single specimen was collected on the 25th February 1932 at Govedi Brod (3) on the Skadar Lake (*Führer*, 1934), a specimen was caught in the valley of the River Neretva (4) on the 10th January 1954 (*Rucner*, 1957). *Krpan* (1980) informs that he has seen the whole flock at Splitsko Polje (16) in February 1956.

Opposite to this in northeast part of country, in the Vojvodina, where the ecological conditions are more convenient, Lesser White-fronted Goose appears relatively regularly, although in a small number. It is particularly frequent in the surroundings of Ečka (5), on the Festucetum-Steppe. There, *ham* has seen more than 1000 specimens of this species in November 1969. In the other parts of Vojvodina it is probably less frequent. The other findings are known: at Batajnica (6) a specimen was caught on the 2nd December 1900 and on the 16th March 1903. Third specimen was collected on the 24th April 1906 near Zemun (7). *Szlavy* (1908) mentioned this species from the surroundings of Novi Sad (8), and *Šoti* (1973) as a rare species from Koviljski rit (9). *Litahorski* sold in 1938 a prepared Lesser White-fronted Gooses hot at Bela Crkva (10) (*Matvejev*, 1950). *Antal* has found this bird at Bačko Gradište (11) in 1952 and again on the 25th January 1955. *Csornai* (1959) has got one specimen of Lesser White-fronted Goose on the 24th January 1957, probably from the surroundings of Senta (12). In the same year *Dević* saw them twice at

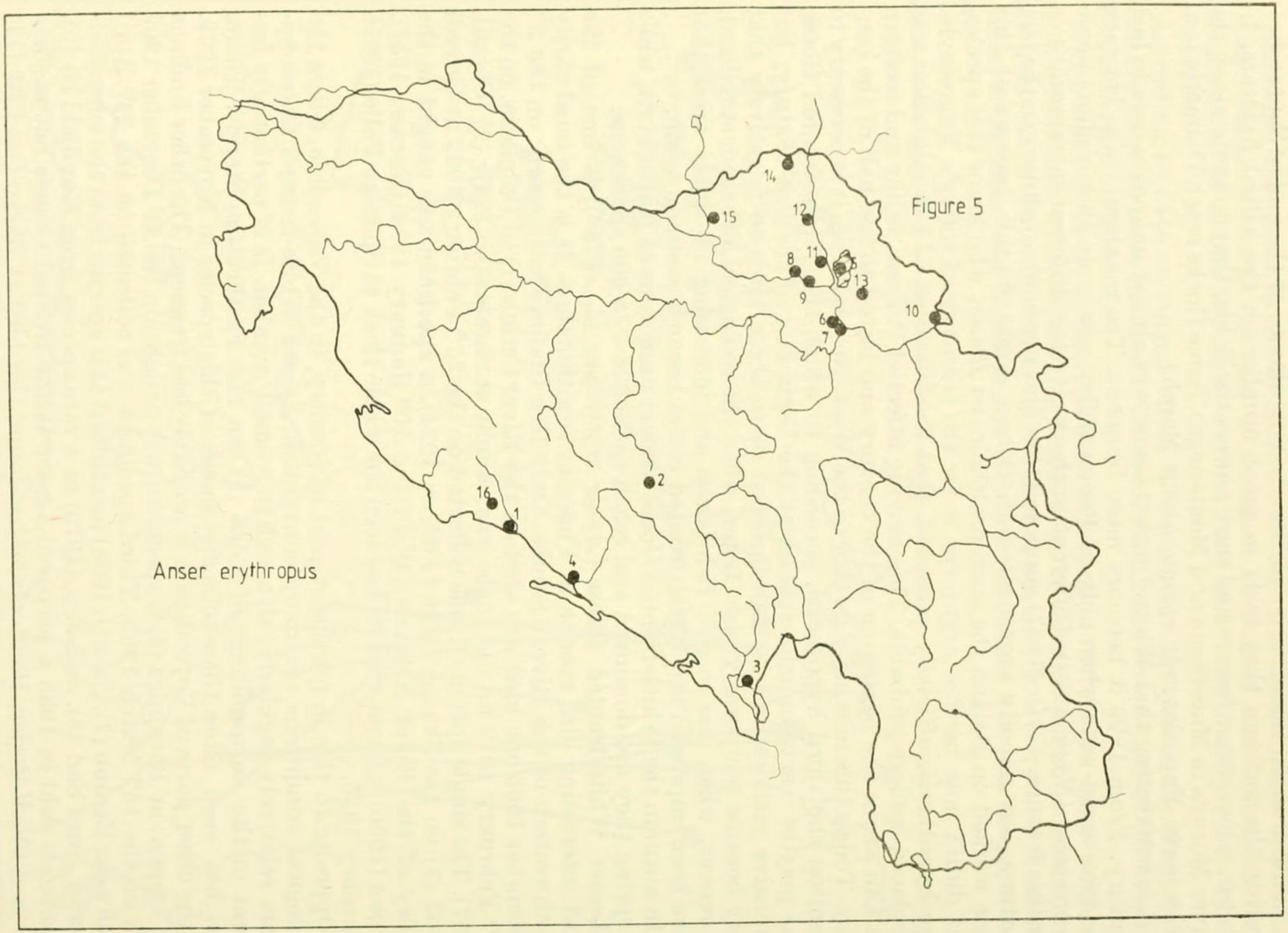

Figure XXIV/5: Anser erythropus

Idvor (13). A specimen was seen on the 28[th] February 1959 at Ludas Lake (14), and on the 25[th] January 1970 were shot two of 16 specimens, which have been seen at Apatin (15) (Figure 5).

So, we can conclude that in Vojvodina where the ecological conditions are suitable Lesser White-fronted Goose is migrant in a moderate number and sometimes it spend the winter although in a small number.

Bean Goose [Anser fabalis (*Latham*, 1787)] is the regular migrant and winter inhabitant. It retains in Yugoslavia from October to March. It appears in smaller flocks on the whole territory of Yugoslavia. In places, where ecological conditions are convenient it appears in a great number. Such an area is Kopački rit where regularly appears 10 000 and more specimens. In the northern parts of Yugoslavia it is most frequent in the October and November. Although a certain number spend the winter here regularly, the main part of population migrates towards south when snow falls and spend the winter in Serbia, Macedonia, Bosnia and Herzegovina (*Karaman*, 1950, *Matvejev*, 1950, *Reiser*, 1939). The birds retain there near unfrozen rivers. Due to shortage of food on this area the birds lose weight, their meat become stinking and slimy and this is the reason of local popular name "slimy bird".

According to *Matvejev* (1950) during the particularly bad years, such as 1928, 1939 and 1941, there were even mass death. In the mediterranean part of Yugoslavia, in Dalmatia, the Bean Geese appear nonregularly, rare (*Krpan*, 1960, 1965, 1970) only in the most severe winters and this is why the people there call this bird "messenger of bad year".

The majority of inspected specimens in Kopački rit belong to the transitive form Anser fabalis × fabalis rossicus. In addition to this at Kopački rit have been determined two subspecies, Anser fabalis rossicus *Buturlin*, 1933 and *Anser fabalis* johanseni *Delacour*, 1951 (*Keve* & *Mikuska*, 1973).

Pink-footed Goose [*Anser brachyrhynchus* (*Baillon*, 1833)] is one of the greatest rarity in Yugoslavia. The only one argumented specimen was caught on the 12[th] January 1905 at Prokuplje (*Reiser*, 1939) (14) (Figure 2). As stated, this species was shot on a several localities, but there are no specimens for argumentation and there is rightly doubt on the accurace of determination.

Conclusions

According to above listed data it is obvious that till today eight wild goose species are noted on the territory of Yugoslavia. Only one species breeds here, but in a small number.

Four species, *Branta bernicla*, *B. leucopsis*, *B. ruficollis* and *Anser brachyrhynchos* are rare. *Anser erythropus* is a regular migrant but appears in a small number on a limited area in the northern part of Yugoslavia. Two species *Anser fabalis* and *Anser albifrons* regularly appear in a great number but less spend the winter here. We don't know where the most of them spend the winter.

Finally, we must point out that in connection with gees migration and spending the winter there are many unexplained questions. Therefore, the most important thing would be to organize the marking of these birds to get the answers on, at least, some of that questions. No doubt we have to help to protect these birds.

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XXV. THE IMPORTANCE OF KOPAČKI RIT

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In Yugoslavia, at the junction of the Rivers Drava and Danube, exists at this moment about 50 000 ha of area preserved of harmful anthropogenous influence.

There are 6234 ha strictly protected, 10 000 ha are a Nature park, and further 23 000 ha is proposed for conservation.

Kopački rit is situated in southeastern part of Baranja, between Rivers Drava and Danube. The entire area of 6234 ha is inundational area. The climate is intermediate between middle-european and continental type of Panon valley. The average monthly temperature in January is −0,8 °C, in July 21,6 °C, while the average yearly temperature is 10,7 °C. Annual precipitations amount is 500 – 700 mm. The altitude of Kopački rit is 80 – 84 m. a. s. The lowest area is the central part with the Kopač Lake. The lake is connected with Rivers Drava and Danube and with other swamps in Reserve by several natural channels. The Reserve is inundated in average 99 days yearly, including 48 days entirely. The rest of year it is dry, but during the most severe drought there is still about 282 ha inundated area in lakes and channels.

The floods may appear in every season, but they are the most frequent in spring and early summer.

The flora of Reserve is a typical wetland flora with reedbeds, sedges and willow woods.

The fauna of Kopački rit and surrounding is very rich. In spite of the fact that evertebrates are not investigated the special shell form *Unio tumidus kopaciensis* and 16 species of leeches confirm it.

In addition to 41 fish species, 10 amphibies, 10 reptils and 51 mammals, the fauna of birds is the reachest with the 270 recordered species.

For the fauna of birds in Kopački rit they are characteristic decimated species which breed there such is: Great White Heron (Casmerodius albus), Black Stork (Ciconia nigra), White-tailed Eagle (Haliaetus albicilla), Saker Falcon (Falco cherrug) etc.

There occur also great colonies of birds and a huge concentration of birds during migration.

The intention is to present here only those characteristics of bird's world in Kopački rit which are interesting for IWRB and causing this area is of the international importance.

Cormorant (Phalacrocorax carbo) breeds on this area. Formely it bred nonregularly or in a small number. Recently, it breeds regularly and the number of breeding pairs increases due to conservations and some convenient

Table XXV/1.
Numbers of breeding pairs of the cormorant in Kopački rit

Year	Number of breeding pairs
1969	0
1970	133
1971	0
1972	78
1973	27
1974	100
1975	100
1976	50
1977	142
1978	366
1979	334
1980	534

ecological factors (Table 1). For the IWRB it is interesting that there are more than 500 breeding pairs and concentrations of several thousand birds.

Kopački rit offers eccelent conditions for herons. Investigations of breeding of these birds from 1954 show that 1021 pairs breed here in average (Table 2). Night Heron (Nycticorax nycticorax) has in average 389 pairs, Squacco Heron (Ardeola ralloides) 195 pairs, Purple Heron (Ardea purpurea) 179 pairs, Little Egret (Egretta garzetta) 133 pairs and Grey Heron (Ardea cinerea) 106 pairs. Now, after ten years pause, Great White Heron (Casmerodius albus) breeds again. There are even to 1000 specimens in winter.

Although not yet breeding Spoonbill (Platalea leucorodia) is very numerous in migration. The concentration of these birds often amounts 500 to 1000 specimens.

Kopački rit is the only locality in Yugoslavia where a Greylag Goose breeds with a significant number, in average 20 – 40 pairs, Bean Goose *(Anser fabalis)* where arrive abundantly in autumn, and White-fronted Goose *(Anser albifrons)* in spring.

Kopački rit has a particular role in the life of different duck species. So far, here are noted 22 species, of which 7 species *(Anas strepera, A. platyrhynchus, A. acuta, A. querquedula, A. clypeata, Aythya ferina, A. nyroca)* are breeding. The concentration of ten or more thousand of ducks belonging to different species is not rare during migration.

Kopački rit is also interesting for waters. When water level is low, these birds arrive in great flocks. The dominant species are Black-tailed Godwit (Limosa limosa), Ruff (Philomachus pugnax), Spotted Redshank (Tringa erythropus), Greenshak (Tringa nebularia) and others.

Table XXV/2.

Number of breeding pairs of Herons in the Kopački rit

Year	Ardea cinerea	Ardea purpurea	Casmerodius albus	Egretta garzetta	Ardeola ralloides	Nycticorax nycticorax	Platalea leucorodia	Plegadis falcinellus	Total
1954	93	193	73	235	478	769	11	27	1852
1955	99	98	51	135	249	393			1125
1956	39	91	36	88	315	358			927
1957	9	145	33	110	215	460			972
1958		209	35	92	380	450			1166
1959		180	30	115	272	270			876
1960		223	38	243	265	417			1186
1961		163	20	205	227	247			862
1962		209	27	117	180	305			838
1963		175	23	110	279	400			977
1964		287	22	88	398	690			1485
1965		271	22	212	407	489			1401
1966		219	9	119	268	370			985
1967		215	5	113	256	339			928
1968		115		100	139	270		4	628
1969	4	130		200	157	225			716
1970	35	198		150	190	330			903
1971	100	250	?	100	50	800			1300
1972	100	300	?	200	50	800			1450
1973	50	200	?	100	50	400			800
1974	150	250	?	100	80	300			880
1975	200	200	?	100	100	100			700
1976	250	200	?	120	100	300			970
1977	350	200	?	150	100	400			1200
1978	400	150	?	100	60	600			1310
1979	400	104	5	100	80	200			889
1980	350	50	5	30	10	100			545
1981	350	50	5	200	15	100			720
Average	106	179	16	133	195	389			1021

Because of limited place, here is presented only a little part of richness of bird's world in Kopački rit. Nevertheless, I hope this is enough to confirm the international importance of Kopački rit with respect to waterfowl.

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XXVI. DISTRIBUTION, NUMBERS AND STATUS OF GEESE IN JAPAN

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Introduction

Ornithological studies of geese in Japan date back to the writings of *Temminck, Blakiston, Seebohm, Stejneger,* and others in the latter half of the 19th century. *Nagamichi Kuroda,* 1912 – 1978, an eminent Japanese ornithologist who laid the foundation for Japanese ornithology during the, pre-war period, has added much to the knowledge on the taxonomy, distribution, status of geese in our country. *Austin and Kuroda* (1953) summarized all the distributional information of Japanese birds up to their time. Since then, however, there had been a very few observations on our geese until the Forestry Agency of the Japanese Government and the Japanese Association for Wild Geese Protection (JAWGP) almost simultaneously organized waterfowl and geese counts around 1970. The capacity of recent observations of wild geese in Japan is probably due to the difficulty of observing them as they have so drastically decreased in numbers.

In the winter of 1969 – 70, on the advice of IWRB, the Forestry Agency initiated a survey of wild geese in Japan as a part of the "National Waterfowl Survey". This survey is still continued as a government project of the Environment Agency, to which the organization of the survey of was transferred from the Forestry Agency in 1971.

The Japanese Association for Wild Geese Protection was established in 1970. The chief objects of the association are the study of geese populations and their preservation in Japan. The present report outlines the current status of geese in Japan, although the data are still insufficient since our research has been carried out for only 10 years.

Organizations and methods of survey

The following two organizations are entirely responsible for the data used in the present report:

– Environment Agency of the Japanese Government. The Environment Agency conducts the survey of the numbers of waterfowl in the middle of January every year. The project has continued since 1970 and the results are published annually. The observers for the survey are forestry and agricultural officers of prefectural governments and officially entrusted wildlife rangers. They count the numbers of geese and ducks both in roosts and in feeding places at many localities ranging throughout the country. The time for counting is from 900 hours until 1200 hours noon; an average of the total numbers of observers is 114 persons.

– Japanese Association for Wild Geese Protection (JAWGP). This association is a private organization founded in 1980 and the authors are among its 40 members. The headquarters of the association is located in Sendai City, about 60 km south of Lake Izunuma, the largest and main wintering ground of wild geese in Japan today. The numbers of geese at Izunuma have been counted by the members of JAWGP at least twice or three times a month since 1971 (*Yokota et al.*, 1979 and 1980). Methods of counting differ for different species. *Anser albifrons* are counted at their morning flight when they move from the roosts to the feeding places. *Anser fabalis* is counted both at the morning flight and while feeding during the daytime, *Branta bernicla* on the other hand, are counted on the sea in the daytime. They are observed either from the sea coast or using a boat.

Since 1976, in addition to the geese counts at Izunuma, we have carried out the counts and observations on geese wintering in other areas of Japan. The subspecies of *Anser fabalis* are identified in the field since 1979.

Species and subspecies of geese wintering in Japan

In goose surveys for 10 seasons from 1971 to 1980, the following four species are recorded every year: *Anser albifrons, Anser fabalis, Branta bernicla* and *Branta canadensis. Anser erythropus* has been observed every year since 1976, the number of birds seen in a season being one to seven individuals. *Anser caerulescens, Anser cygnoides* and *Anser anser,* on the other hand, winter in our country only once every two or three seasons and the number of birds seen was one to three a season. *Anser canagicus* was recorded only once (one individual). Altogether nine species of geese have been known to occur in Japan, of which three species *(A. albifrons, A. fabalis* and *B. bernicla)* are regular winter visitors today. Two species *(B. canadensis* and *A. erythropus)* are also regular winter visitors but few in number. The other four species are either irregular winter visitors in very small numbers *(A. caerulescens, A. cygnoides* and *A. anser)* or a straggler *(A. canaginus)* although at least two of them *(A. caerulescens* and *A. cygnoides)* were regular visitors in early times (*Kuroda,* 1939; *Austin* and *Kuroda,* 1953).

The subspecies of geese wintering in Japan are as follows: *Anser albifrons frontalis, Anser fabalis serrirostris* and *A. f. middendorffii, Branta bernicla orientalis,* and *Branta canadensis leucopareia* and *B. c. minima.*

B. c. leucopareia have been observed every year since 1970 and the number of birds recorded was one to three in each season. A single specimen of *B. c. minima* was taken in Tokyo Bay before 1894 (*Kuroda,* 1952); one individual was seen again at Lakes Izunuma and Uchinuma in 1979/80 (*Kurechi and Hiraizumi,* 1981). The chief characteristics of these species and subspecies in the field are shown in Table 1. Among *Anser fabalis* the subspecific intermediates between *serrirostris* and *middendorffii* constitute about 10 – 20% of the total *A. fabalis* population.

Winter areas and staging places

In this report "wintering area" denotes the area where geese stay from September/October to March/April. "Staging place" is an area where they rest for less than one month in autumn and/or spring on their migration route.

There are nine such wintering areas in Japan, eight in Honshu and one in Hokkaido. The staging places are thirteen in number, two in Honshu and eleven in Hokkaido. They are shown in Fig. 1.

A. albifrons has three wintering areas: Katano-no-Kamoike (2), Sado Island (4) and Lake Izunuma (6). It uses five staging places: Hachiro-gata (10), Lake Ogawara (11), Lake Utonai (12), Ishikari Plain (13) and Seika-ko (14).

A. fabalis has five wintering areas and ten staging places. The only known wintering area of *A. f. serrirostris* is Lake Izunuma (6); its staging places are Lake Ogawara (11), Lake Utonai (12), Kushiro Marsh Plain (17), Furen-ko (18) and Notoro-ko (21). *A. f. middendorffii,* on the other hand, uses five wintering areas: Lake Biwa (1), Katano-no-Kamoike (2), Asahi-ike (3), Fukushima-gata (5) and Lake Izunuma (6). There have been four staging places for *A. f. middendorffii:* Hachiro-gata (10), Lake Utonai (12), Ikusota-numa (16) and Teshio Plain (22). Furthermore, small flocks of *A. f. middendorffii* have been observed at Ishikari Plain (13), Yueo-numa and Chobushinuma (15), Kushiro Marsh Plain (17) and Furen-ko (18) during migration. The subspecies of *A. fabalis* staging at Tofutsu-ko (20) has not yet been identified.

As far as it is known, *B. bernicla* winters in three areas, each with a population of more than one hundred: Sendai Bay (7), Mutsu Bay (8) and Hakodate Bay (9). Although there may be some unknown wintering areas in Japan, any *B. bernicla* missed would be small in number. Nevertheless it must be admitted that information on the wintering areas and numbers of *B. bernicla* is much less accurate than that on the other species.

The wintering area of *B. c. leucopareia* is Lake Izunuma (6) and their staging places are Hachiro-gata (10) and Ishikari Plain (13). In recent years both *B. c. leucopareia* and *B. c. minima* have always been found mingled in large flocks of *A. albifrons.*

Numbers of geese

The recent numbers of geese wintering in Japan are shown in Table 2. The total numbers are estimated at between 10 000 and 15 000 birds.

A. albifrons constitutes about 60%, *A. fabalis* about 35% (*A. f. serrirostris* 12% and *A. f. middendorffii* 23%) and *B. bernicla* about 5% of the total. The numbers of *B. c. leucopareia* and *A. erythropus* are very small, so far one to seven birds being seen each season.

Table 3 shows the results of the geese survey by the Environment Agency. These figures are considered very valuable information. Nevertheless, as commented by *Horiuchi* (1974), who said that "these numbers are not necessarily enough to estimate the total numbers of geese wintering in our country", the numbers of geese by the survey of the Environment Agency and those by JAWGP do not always agree. The results of the two surveys at Lake Izunuma are given in Table 4 and Fig. 2 for comparison.

The numbers of geese given by the Environment Agency are approxi-

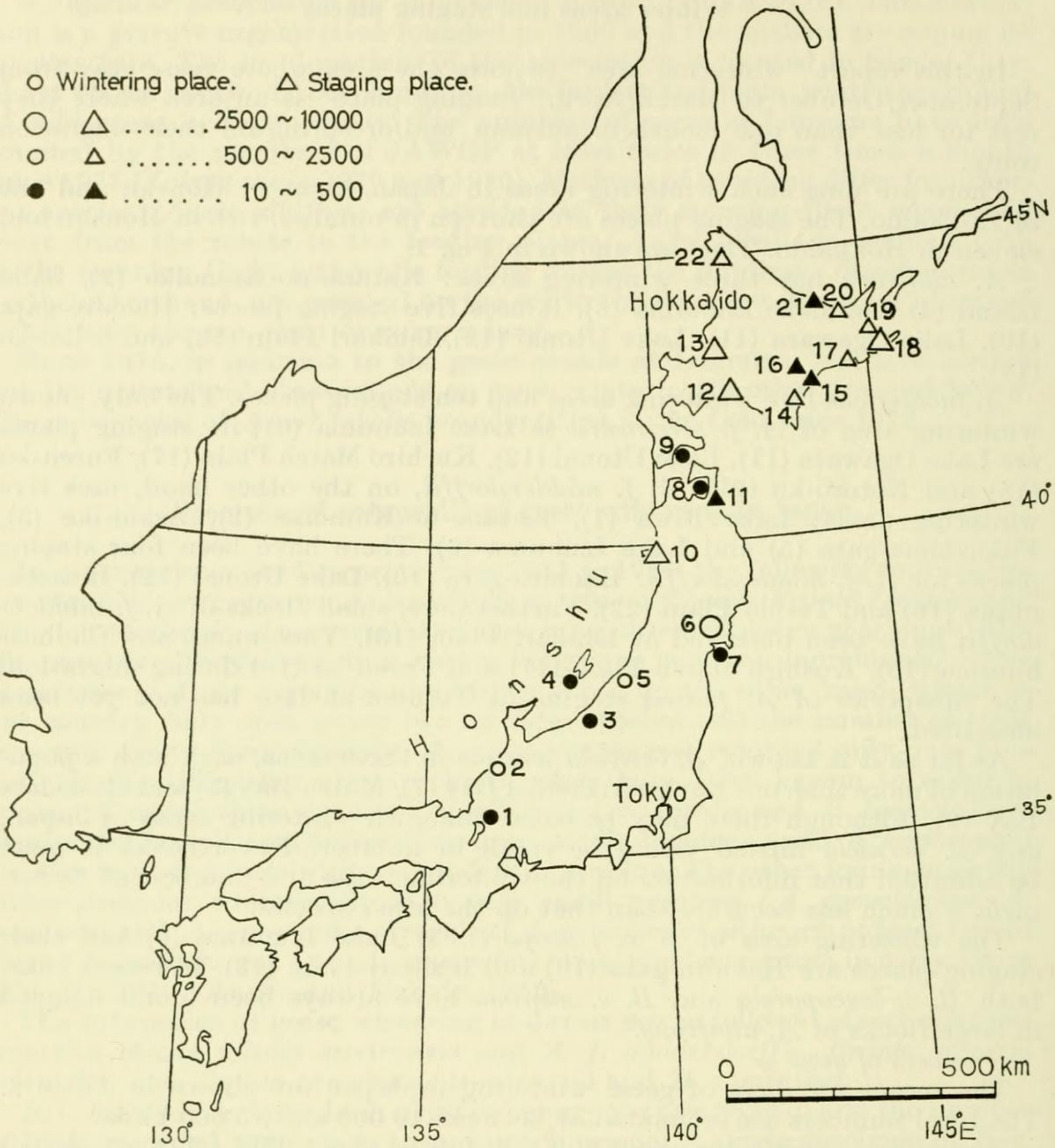

Figure XXVI/1: Wintering and staging places of geese in Japan, 1975–80. Wintering place: 1. Lake Biwa, 2. Katano-no-kamoike, 3. Asahi ike, 4. Sando Island, 5. Fukushima gata, 6. Lake Izunuma, 7. Sendai Bay, 8. Mutsu Bay, 9. Hakodate Bay. – Staging place: 10. Hachiro-gata, 11. Lake Ogawarako, 12. Lake Utonai, 13. Ishikari Plain, 14. Seika-ko, 15. Yudo-numa and Chobushi-numa, 16. Ikusota-numa, 17. Kushiro Marsh, 18. Furen-ko, 19. Odaito, 20. Tofutsu-ko, 21. Notoro-ko, 22. Teshio Plain (JAWGP) mately 30% less than those of JAWGP. The data and frequency of counts are chiefly responsible for the difference in result. At Lake Izunuma, JAWGP conducts its geese counts at least once or twice a month throughout the wintering period of geese. On the contrary, the Environment Agency's count is made only once a year in the middle of January. The middle of January is almost the coldest time of the year and there is sometimes much snow fall in northern Japan. According to JAWGP observations, the very severe weather and snow at times make the geese at Lake Izunuma disperse and move to the south suddenly, causing under-estimation of the goose populations. The same may be true of the other wintering areas, most of which are located in the northern half of the country (Fig. 1).

It is therefore suggested that early December, or any date just prior to snow fall, is the most suitable time for geese survey in Japan.

Migration routes in Japan

It is preasumed that geese wintering in Japan come from and go back to the north and the northeast, since there is no record or observation of geese migrating to our country through the Korean Peninsula or direct from the Premorski region across the Sea of Japan. To trace the migration routes of geese within Japan, two methods were used.

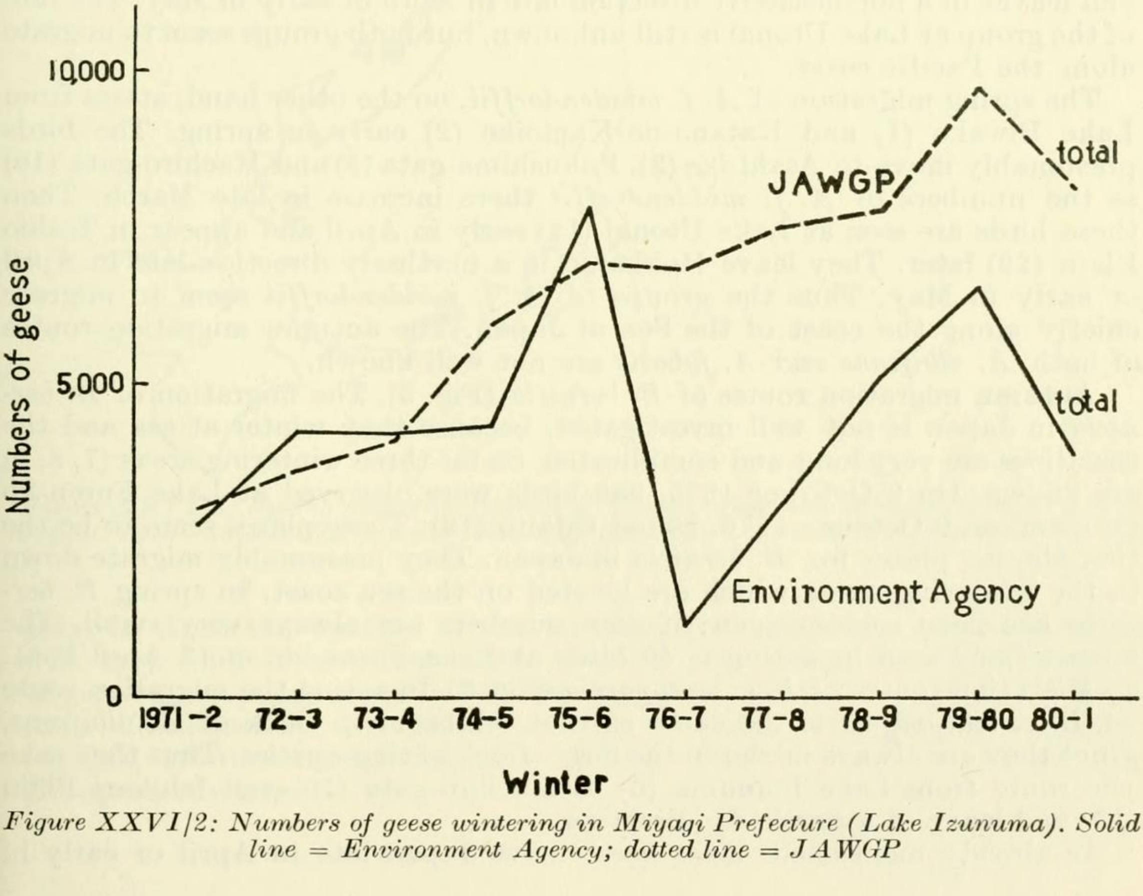

Figure XXVI/2: Numbers of geese wintering in Miyagi Prefecture (Lake Izunuma). Solid line = Environment Agency; dotted line = JAWGP

One method is to infer the movements of geese by counting their numbers at the wintering and staging places and arranging those results in the order of date. The other method is to use rare species or particular individuals as "markers". For example, *Branta canadensis leucopareia, Anser caerulescens, Anser cygnoides,* and in one case a part albino *Anser fabalis* were used to investigate the migration routes.

These two methods have been found reliable enough in such a country as Japan, where the number of geese are not very large and the country stretches from south to north for a long distance. The banding of geese has not yet been done, but attempts will be made in the very near future. The migration routes thus brought out are outlined below.

Spring migration routes for *A. albifrons* (Fig. 3). The larger flock (5000 – 6000 birds) starts from Lake Izunuma (6) and migrates through Hichiro-gata (10) and Ishikari Plain (13); this group leaves the country in a northerly direction late in April or early in May. The smaller flock (1000 – 2000 birds) of Izunuma birds takes the route to Lake Utonai (12) and then to Seika-ko (14); the group presumably leaves in a northeasterly direction around the end of April. The migration routes of the flocks which winter at Katano-no-Kamoike (2) and on Sado Island (4) are not yet certain.

Spring migration routes of *A. fabalis* (Fig. 4). The group of *A f. serrirostris* from Izunuma seems to divide into two smaller groups when migrating back to the north. One group takes the route to Lake Utonai (12) and the other to Kushiro Marsh Plain (17). The latter group then moves to Furen-ko (18) and leaves in a northeasterly direction late in April or early in May. The fate of the group at Lake Utonai is still unknown, but both groups seem to migrate along the Pacific coast.

The spring migration of *A. f. middendorffii*, on the other hand, starts from Lake Biwako (1) and Katano-no-Kamoike (2) early in spring. The birds presumably move to Asahi-ike (3), Fukushima-gata (5) and Hachiro-gata (10) as the numbers of *A. f. middendorffii* there increase in late March. Then these birds are seen at Lake Utonai (12) early in April and appear in Teshio Plain (22) later. They leave Hokkaido in a northerly direction late in April or early in May. Thus the groups of *A. f. middendorffii* seem to migrate chiefly along the coast of the Sea of Japan. The autumn migration routes of both *A. albifrons* and *A. fabalis* are not well known.

Autumn migration routes of *B. bernicla* (Fig. 5). The migration of *B. bernicla* in Japan is not well investigated, because they winter at sea and the coastlines are very long and complicated. So far three wintering areas (7, 8, 9) are known. On 9 October 1975, 980 birds were observed at Lake Furen-ko (18), and on 9 October 1976, 900 at Odaito (19). These places seem to be the first staging places for *B. bernicla* in Japan. They presumably migrate down to the wintering areas which are located on the sea coast. In spring *B. bernicla* has been seldom seen; if seen numbers are always very small. The largest flock seen in spring is 40 birds at Lake Furen-ko on 13 April 1981.

Migration routes of *B. c. leucopareia* (Fig. 3). In spring the migration route of *B. c. leucopareia* is the same as that of the main flock of *A. albifrons*, since they are always mixed in the large flock of that species. Thus they take the route from Lake Izunuma (6) to Hachiro-gata (10) and Ishikari Plain (13) and leave in a northerly direction.

As already mentioned, most geese leave Japan late in April or early in

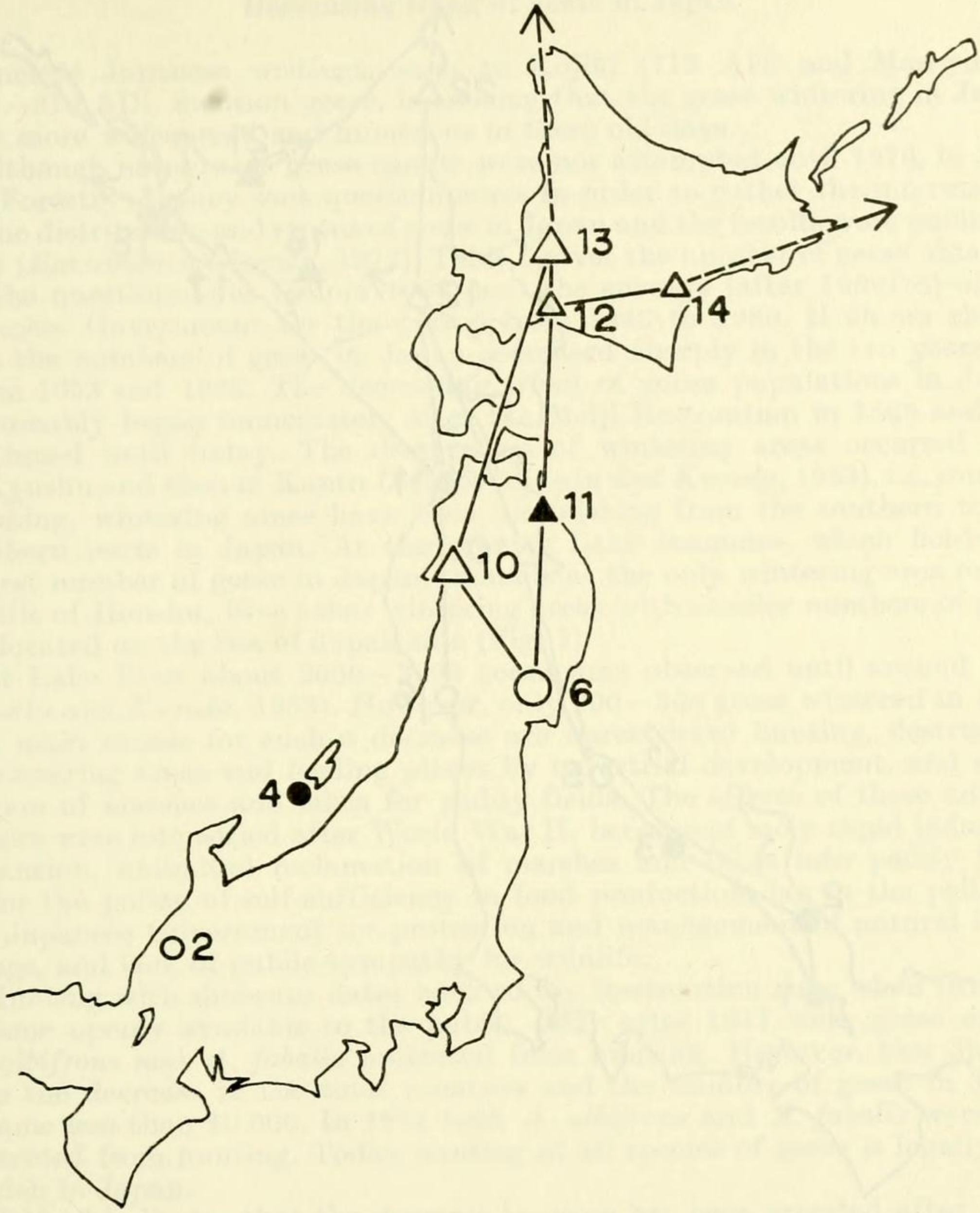

Figure XXVI/3: Spring migration courses of White-fronted and Aleutian Canada geese in Japan (1975 – 80, JAWGP). Solid line = migration courses; dotted line presumed migration courses

May. In April the weather of the breeding grounds in the north should be still very cold. It becomes milder towards May. Thus the departure time of geese corresponds roughly with the northern climate in extreme northeast Asia. Consequently, the departure time is about the same as in Europe (*Ogilvie*, 1978), although Japan is situated further south in latitude than European countries.

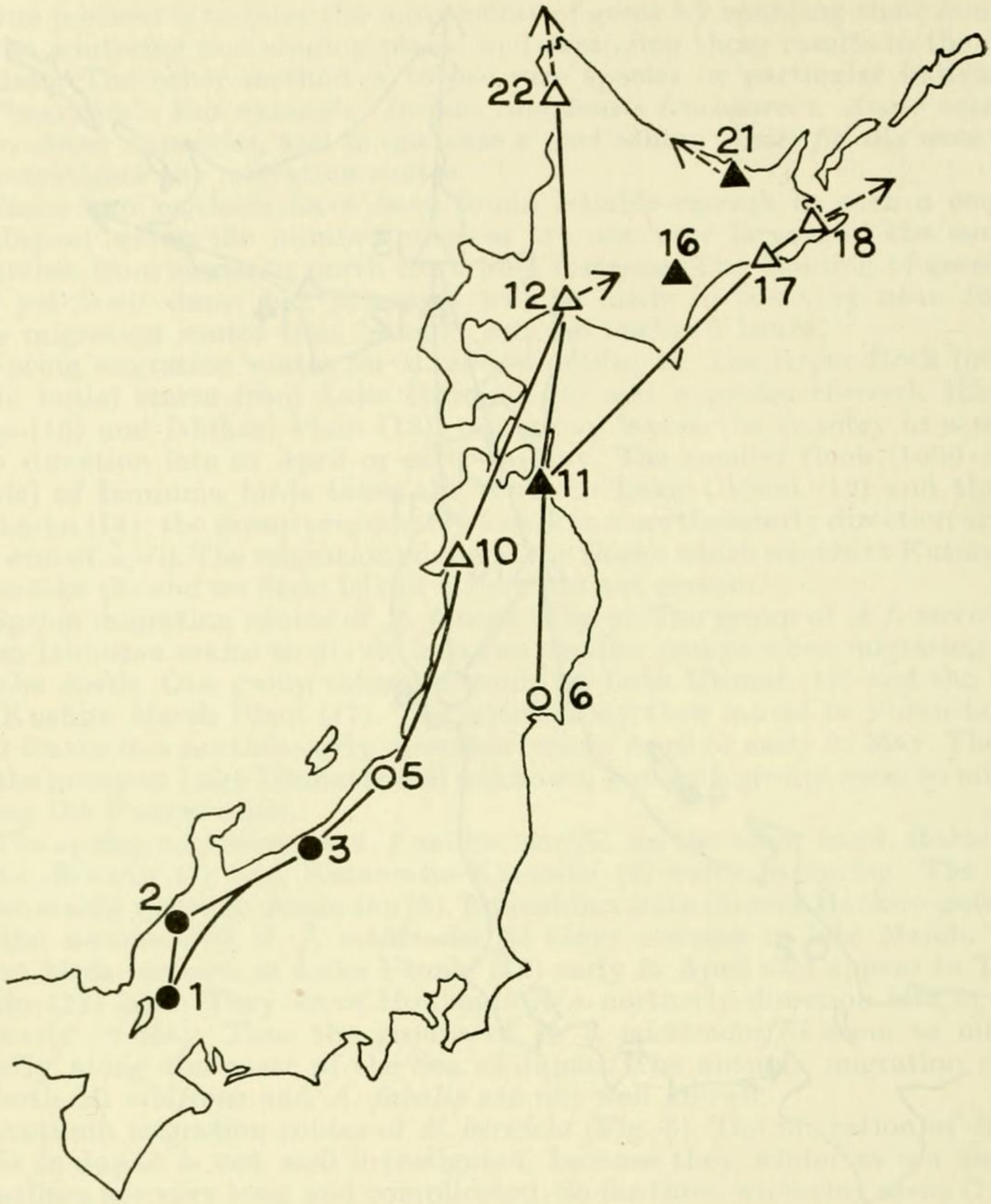

Figure XXVI/4: Spring migration courses of Bean Geese in Japan (1975 – 80). (JAWGP). See Fig. XXVI/3 for explanations

Decreasing trend of geese in Japan

Ancient Japanese writings, such as Kojiki (712 AD) and Man-yo-shu (780 – 810 AD), mention geese, indicating that the geese wintering in Japan were more widespread and numerous in these old days.

Although nationwide geese counts were not attempted until 1970, in 1964 the Forestry Agency sent questionnaires in order to gather the information on the distribution and status of geese in Japan and the results were published later (*Environment Agency*, 1972). Table 5 gives the number of geese obtained by the questionnaires (before 1963) and the surveys (after 1969/70) of the Japanese Government for the period from 1943 to 1980. It shows clearly that the numbers of geese in Japan decreased sharply in the ten years between 1953 and 1963. The decreasing trend of goose populations in Japan presumably began immediately after the Meiji Restoration in 1868 and has continued until today. The destruction of wintering areas occurred first in Kyushu and then in Kanto District (*Austin and Kuroda*, 1953), i.e. roughly speaking, wintering areas have been diminishing from the southern to the northern parts in Japan. At the present Lake Izunuma, which holds the largest number of geese in Japan, remains as the only wintering area on the Pacific of Honshu. Five other wintering areas with smaller numbers of geese are located on the Sea of Japan side (Fig. 1).

At Lake Biwa about 2000 – 3000 geese were observed until around 1946 (*Austin and Kuroda*, 1953). However, only 200 – 300 geese wintered in 1980. The main causes for such a decrease are unrestricted hunting, destruction of wintering areas and feeding places by industrial development, and reclamation of marshes and lakes for paddy fields. The effects of these adverse factors were intensified after World War II, because of more rapid industrial expansion, unlimited reclamation of marshes and lakes into paddy fields under the policy of self-sufficiency in food production, lag in the policy of the Japanese Government for protection and management of natural living things, and lack of public sympathy for wildlife.

Hunting with shotguns dates back to the Restoration time when firearms became openly available to the public. Only after 1947 were geese except *A. albifrons* and *A. fabalis* protected from hunting. However, this did not stop the decrease in the total numbers and the number of geese in Japan became less than 10 000. In 1971 both *A. albifrons* and *A. fabalis* were also protected from hunting. Today hunting of all species of geese is legally forbidden in Japan.

Table 3 indicates that the decrease in geese has been arrested after 1971; in some areas, geese have even been increasing slightly in the past 10 years. Goose counts at Lake Izunuma (Table 4, Fig. 2) also indicate that hunting prohibition was an effective measure to improve the wintering goose populations.

It should be emphasized, however, that the deterioration of the natural environment is still progressing rapidly, so the grievous possibility of extinction of geese in Japan cannot be ruled out.

It is therefore urgently necessary to establish a drastic policy in order to preserve geese permanently.

Some features of Japanese geese

The situations peculiar to Japanese geese should be mentioned:

(i) Cause of rapid decrease.

Since the Meiji Restoration in 1868, industrial development and hunting have been favoured by the Japanese as evidence of western modernization, which has had so much influence on national thinking. Industrial development accelerated even more after World War II.

There is a strong correlation between the decrease of geese and social and economic reform in Japan. Such conditions may be seen in many countries over the world, but Japan is a rare case in which radical changes took place so quickly within a short time. Consequently, the geese of Japan diminished very rapidly after the Restoration.

So a really difficult question is posed: will the geese, which are now under complete protection from hunting, recover their original distribution and numbers if some measure for preserving their wintering areas are taken in future? In any case, hunting, industrial development, and reclamation of marshes and lakes are undoubtedly more important factors to be considered for preserving the geese wintering in our country.

(ii) Feeding habits of Japanese geese

There are some differences in feeding habits between Japanese and European geese. In Japan *A. albifrons* and *A. fabalis* feed chiefly on dispersed rice and gleanings on paddy fields. They supplement their food with the grasses on the edges of paddy fields and some water plants (e. g. *Trapa* spp., *Zizania latifolia*, etc.) in marshes. However, when they settle in northern and northeastern most staging places in Hokkaido on their northward migration, they feed mainly on grasses and remains of farm products as they do in Europe (*Yokota et al.*, 1978).

B. bernicla in Japan feed mainly on *Zostera marina* and *Enteromorpha* spp. They feed on cultured laver *Porphyra* spp. when *Zostera* and *Enteromorpha* are in short supply. The cultured laver is one of the important sea products in Japan. In any case, *B. bernicla* feed exclusively on the surface of the sea in Japan and have never been seen feeding on the land as they do in Europe (cf. *Owen*, 1978).

Acknowledgements

The authors are extremely grateful to *dr. Hiroyuki Morioka* of the Ornithological Society of Japan for his helpful criticism of the first draft of our manuscript. They are also deeply indebted to the members of the Japanese Association for Wild Geese Protection and of the Wild Bird Club in Tohoku University for their endeavours in geese counts and migration route surveys. Mr. Nobuo Takeshita kindly prepared the illustration.

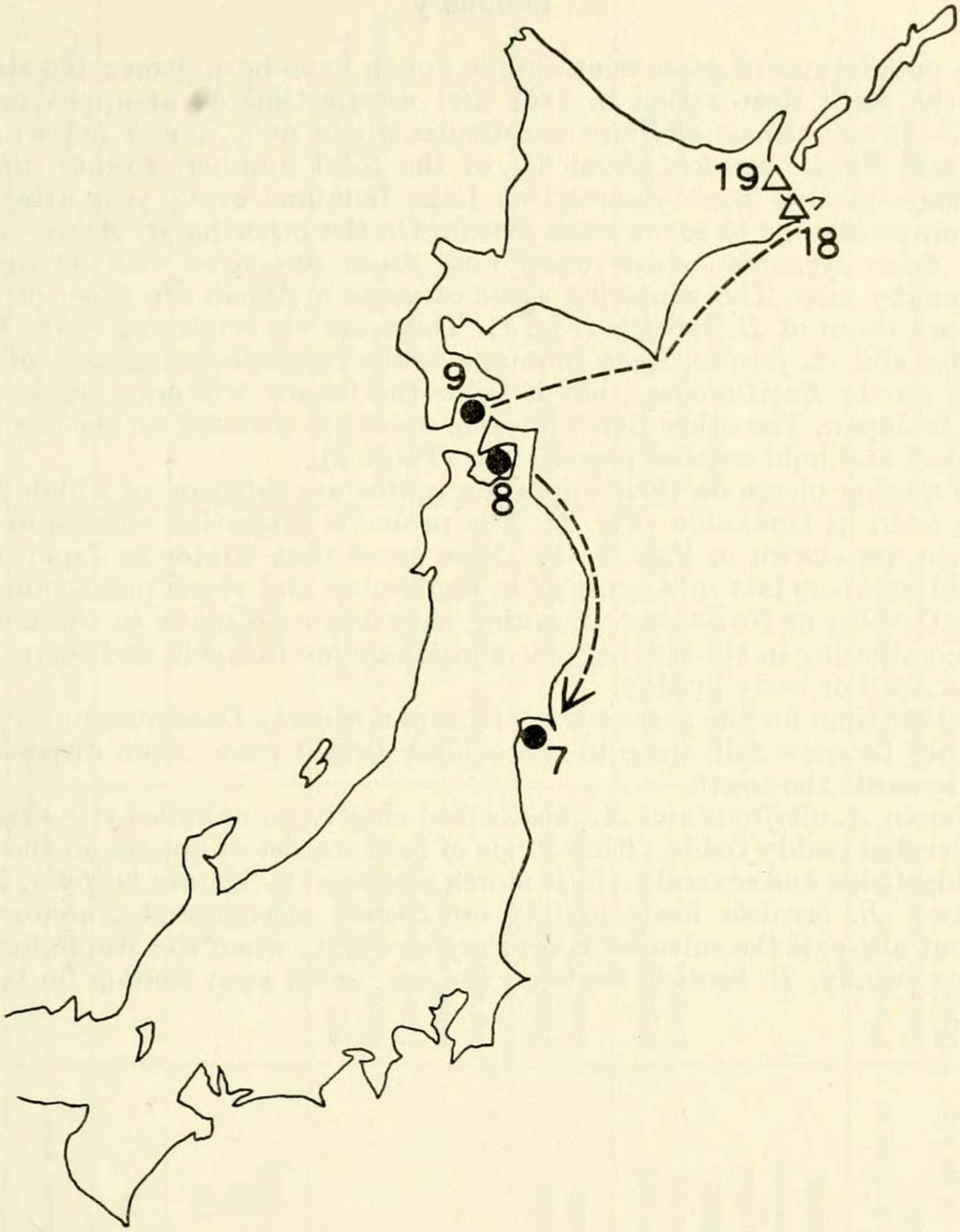

Figure XXVI/5: Autumn migration course of Black Brants in Japan (1975 – 1980) (JAWGP). See Fig. XXVI/3 for explanations

Summary

The populations of geese wintering in Japan have been decreasing steadily since the Meiji Restoration in 1868 and were estimated at approximately 10 000 – 15 000. *Anser albifrons* constitutes about 60%, *Anser fabalis* about 35%, and *Branta bernicla* about 5% of the total number. *Branta canadensis leucopareia* has been observed at Lake Izunuma every year after 1976 and numbering one to seven each season. On the other hand, *Anser caerulescens, Anser cygnoides, Anser anser* and *Anser canagicus* visit Japan only occasionally now. The wintering areas of geese in Japan are nine, of which three are those of *B. bernicla* (Fig. 1). There are six wintering areas for *A. albifrons* and *A. fabalis*. Lake Izunuma is the only wintering area of these species on the Pacific coast, but it holds the largest wintering goose population in Japan. The other five wintering areas are situated on the Sea of Japan coast and hold smaller populations (Table 2).

The staging places on their migration routes are thirteen, of which eleven are situated in Hokkaido (Fig. 1). The probable migration courses of geese in Japan are shown in Figs. 3 – 5. Those geese that winter in Japan arrive in small numbers late in August or in September and reach maximum numbers in October or November. In spring they begin to move to the north in March, gathering in the staging places in Hokkaido in April, and leave Japan late in April or early in May.

The best time for the geese survey in Japan is early December or any time just prior to snow fall, since in the coldest period geese often disperse and move towards the south.

In Japan *A. albifrons* and *A. fabalis* feed chiefly on unhulled rice scattered on harvested paddy fields. Other kinds of food consist of grasses on the edges of paddy fields and several aquatic marsh plants (e. g. *Zizania latifolia, Trapa* spp etc.). *B. bernicla* feeds mainly on *Zostera merina* and *Enteromorpha* spp., but also eats the cultured laver *Porphyra* spp., when the staple food are in short supply. *B. bernicla* feeds on the sea, never seen feeding on land in Japan.

Table XXVI/1.

Identification keys of the species or subspecies of geese in Japan

		White-fronted goose	Bean goose		Brent goose (Black Brant)	Aleutian canada goose
			serrirostris	middendorfi		
Measurement mm	Number of ex	11	19	30	1	3
	Wing chord	421	470	798.3	338	402
	Culmen	50	69.3	79.4	33.4	35.5
	Tarsus	72.9	85.4	88.1	59.1	78.1
Characteristics on appearance			Bill is shorter than middeldorfi's Lower mandible much curved outward	Body is larger than serris. Bill and neck longer than serris. Bill is slender and straight	Lower breast and abdomen are fulginous brown	White ring at the base of neck
Voice		Clearer than Bean goose	Thicker and lower than Whitefronts	Deeper than serris Honking voice	Metallic	
Food		Unhulled rice dispersed on paddy fields. Grass on foot path between paddy fields	Same as White-fronts	Zissania and Trapa but also unhulled rice on paddy fields	Zostera, Entero-morpha and Por-phyra on seafarm	Same as whitefronts
Feeding behaviour		Morning and even-ing flights. Feeding on paddy fields in larger flocks	Feeding on paddy fields in smaller flocks	Feeding on marsh, pond and at lake coast also on paddy fields in smaller groups	At sea coast and on sea surface, when feed on Porphyra	Feed inter-mingled with flock of whitefronts

Table XXVI/2.

The numbers of geese at different haunts in Japan
(1975 – 76 – 1980 – 81)

JAWGP

No.	Name of haunts	District[1]	White-fronted geese	Bean geese		Black Brant	Aleutian Canada geese
				serrirostris	middendorfi		
	Wintering place						
1	Lake Biwa	Shiga			200 – 300		
2	Katano-ng-Kamaike	Ishikawa	500 – 1000		300 – 500		
3	Asahi-ike	Niigata			100 – 200		
4	Sado Island	Niigata	40 – 70				
5	Fukushima	Niigata			1500 – 2500		
6	Lake Izumuna	Miyagi	6000 – 7000	1000 – 2000	50 – 120		1 – 2
7	Sendai Bay	Miyagi				100 – 200	
8	Mutsu Bay	Amoari				300 – 400	
9	Hakodate Bay	Toshima(H)				100 – 150	
	Staging place[2]						
10	Hachiro-gata	Akita	4000 – 6000		1000 – 5000		1 – 2
11	Ogawara-ko	Amori	50 – 300	100 – 200			
12	Lake Utonai	Iburi (H)	1000 – 3000	500 – 1000	1000 – 2000		
13	Ishikari Pl.	Ishikari (H)	5000 – 6000		20 – 100		1 – 2
14	Seika-ko	Tokachi (H)	1000 – 1500				

15	Yudo-numa-Chobushi n.	Tokachi (H)			200 – 300	
16	Ikusota-numa	Tokachi (H)			300 – 500	
17	Kushiro Marsh	Kushiro (H)		400 – 1000		
18	Furen-ko	Nemuro (H)		1000 – 1500		980
19	Odaito	Nemuro (H)				900
20	Tofutsu-ko	Abashiri (H)		200	600[3]	
21	Nataro-ko	Abashiri (H)		200 – 400		
22	Teshio Plain	Soya-Rumori (H)			1000 – 1500	

[1]. Provinces in Hokkaido are designated by (H); others are in Honshu.
[2]. The numbers of geese at staging places are the numbers on spring migration except at 18 and 19.
[3]. Subspecies of Bean geese at Tofutsu-ko are not determined.

Table XXVI/3.

Results of geese counting in Japan (1969 – 1980)

Environment Agency

Winter	No. of obs.	Frequeney of count in the year	White-fronted goose	Bean goose	Brent goose	Bcl	Aa	Ae	Ac	Acy	Sp. un-deter-mined	Total
1969 – 70	85	1	3726	1500	339							5565
1970 – 71	69	1	3385	1615	160							5160
1971 – 72	98	1	3485	1899	290						119	5793
1972 – 73	70	1	4991	1554	256						380	7181
1973 – 74	104	1	4596	1466	202	2	2	3	1	1	977	7250
1974 – 75	182	1	3611	2420	146						1072	7249
1975 – 76	152	1	5962	4896	104	2					58	11022
1976 – 77	153	1	2900	2466	374						156	5897
1977 – 78	109	1	4019	1969	140			3				6131
1978 – 79	116	1	5171	1797	236	1		1			624	7830
1979 – 80	123	1	7079	1857	170	2	2	2			48	9161
1980 – 81	114	1	3436	3877	161		1				33	7508
12 winters	aver-age 114	1	4364	2276	215						385	7146

Bcl = *Branta canadensis leucopareia* – Aleutian Canada goose
Aa = *Anser anser* – Greylag goose
ae = *Anser erythropus* – Lesser White-fronted goose
Ac = *Anser caerulescens* – Snow goose
Acy = *Anser cygnoides* – Swan goose

Table XXVI. 4.

Results of geese counts in Miyagi Prefecture (Lake Igunuma)

Winter	Environment Agency							JAWGP[3]									
	Frequency of counts in the year	White-fronted geese	Bean geese	Brent geese	Other species	Species undetermined	Total	Frequency of counts in the year	White-fronted geese	Bean geese	Brent geese	B[2]cl	B[4]cm	Ae	Ac	Acy	Total
1969 – 70	1	2162	122				2284										
1970 – 71	1	2003	828				2831					1					
1971 – 72	1	2365	273	87		66	2791	25			56	1					3000
1972 – 73	1	3233	661			330	4224	48	3400	230	38	1					3669
1973 – 74	1	3013	482	14	1[2]	699	4211	32	3644	294	123	3			1		4065
1974 – 75	1	3325	1018			1000	4343	49	4316	1419	118	2					5927
1975 – 76	1	4654	3075		2[2]	28	7759	43	4325	2468	120	2		1	1		6917
1976 – 77	1	771	250	31		90	1142	42	5300	1501	21	2		2			6826
1977 – 78	1	3013	53				3066	42	5590	1800	100	2		7			7499
1978 – 79	1	4269	228			591	5090	49	5753	1809	200	1		4			7767
1979 – 80	1	6077	390		2[2]	26	6495	72	7600	1950	184	1		3			9738
1980 – 81	1	2775	1085			20	3880	28	6265	1606	262	2	1	2			8139
Average	1	3085	705			317	4010	43	5132	4406	122						6354

1. *Anser caerulescens*
2. *Brenta canadensis leucopareia*
3. *Numbers of geese are peatz number in the winter*
4. *Branta canadensis minima*

Table XXVI/5.

Decrease in the numbers of geese – observed sites in Japan for past 38 years

Environment Agency

Year	Geese observed sites		Number of geese		Method of survey
	Number, %		Number, %		
1943	149	100	62300	100	Questionaire in 1964
1953	140	94	54200	87	
1963	57	38	9300	15	
1969 – 70	40	27	5542	9	Direct counts
1970 – 71	27	20	5161	8	
1971 – 72	All geese were prohibited to hunt				
	42	28	5793	9	
1972 – 73	34	23	7181	12	
1980 – 81	46	31	7508	12	

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XXVII. POPULATION DYNAMICS OF SVALBARD BARNACLE GEESE 1979–1980

M. Owen

The rate, pattern and causes of mortality as determined by individual marking

The population of Barnacle Geese *Branta leucopsis* breeding in Svalbard and wintering in the Solway Firth in northern Britain was, until the mid 1960s, the smallest goose population in western Europe. Then, following intensive conservation both on the wintering and breeding ground, numbers increased, to 3000–4000 in the 1960s and even more dramatically in the 1970s. Early ringing had suggested that the population was closed and quite discrete from the Greenland and Siberian populations, which winter respectively in north western parts of the British Isles and in the Netherlands (*Boyd*, 1961). The dynamics of the population during the early growth period was described by *Owen and Norderhaug* (1977). The main technique of estimating mortality was through counts of total numbers and breeding success, both of which had been assessed fairly accurately since 1958. The population is legally protected from shooting throughout its range.

In 1970 an intensive study of population ecology was started, using individual marking as well as intensive counting and breeding assessment to investigate the behaviour of the population. This paper presents a progress report, concentrating on estimates of mortality using large samples of ringed birds. The range in winter, on migration and in the breeding season are shown in Fig. 1.

Ringing programme and methods

The aim of the individual marking programme was to provide an estimate of mortality independent of counts and age ratio estimates, both of which are subject to errors, and to investigate age-specific and sex-specific mortality. The population had failed to expand further in the 1960s despite good breeding, suggesting that a density-dependent mortality factor was operating. In addition ringed birds would provide information on longevity and on breeding success of individuals in relation to age, on pair formation and stability, family relationships and many other factors of importance in population studies.

Individually coded plastic rings as described by *Ogilvie* (1972) were used and the first successful catches were made on the breeding grounds in 1973 (*Jackson et al.*, 1974). Numbers ringed and recaptured during and since that expedition are given in Table 1. Nearly two thirds of individuals were caught in summer roundups and the remainder, with the exception of a few birds, with rocket nets on the Solway. In addition there were about 1100

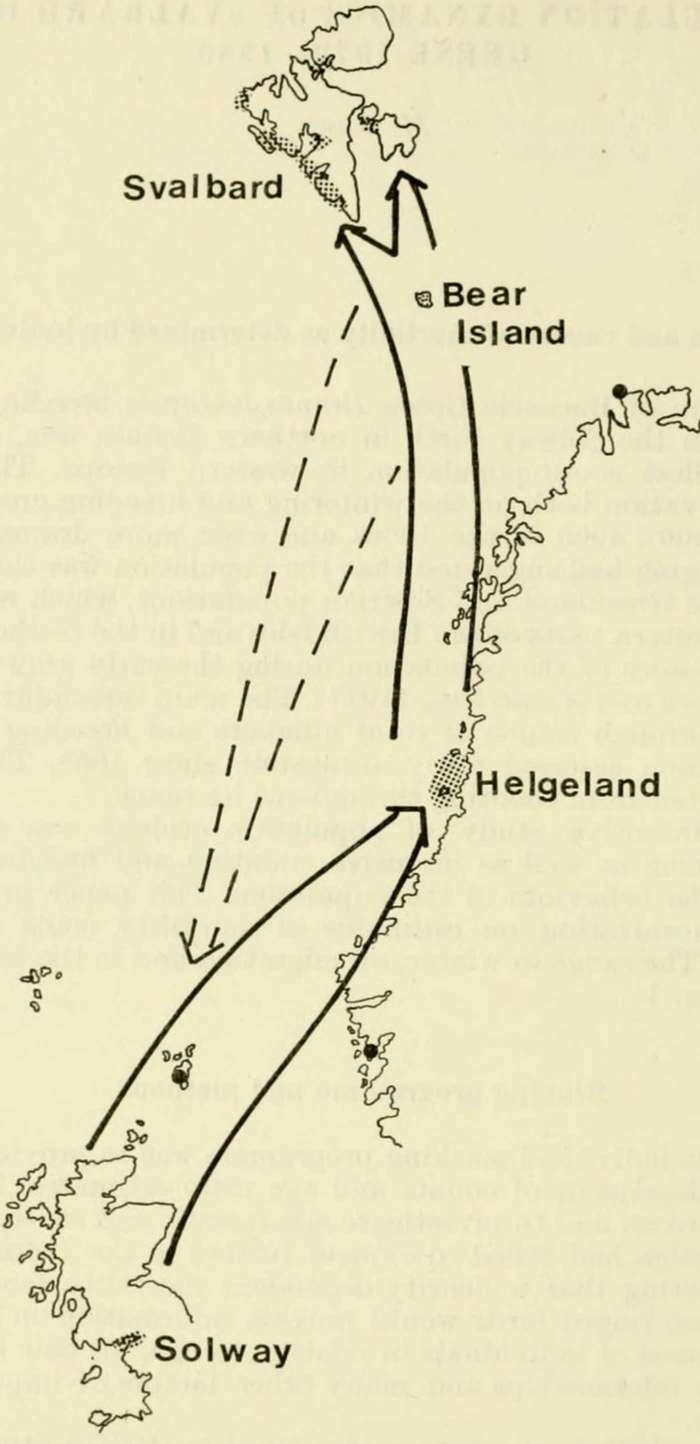

Figure XXVII/1: The winter, breeding and migration range of Svalbard Barnacle Geese. Shaded areas indicate areas occupied at different times and arrows likely routes taken between haunts. The dashed line is the autumn route probably taken by the majority of birds from the Bear Island staging area recaptures of individually marked birds, though nearly half of these were in summer, only a few days after marking. Of the 2158 adults 37 had been caught in the 1960s, most in intensive catching efforts in 1962–64, both in Svalbard and Britain. A number of birds marked in 1962, now at least 20 years old, remain in the population.

Most rings were yellow with an engraved black 3-letter code but birds marked as goslings or yearlings were given rings with strips of tape of a different colour stuck on them so that these birds could be distinguished in the field. In later years of the study orange and white rings with two digits were used to facilitate the study of small groups of birds for special projects. Plumage dyes on the under tail coverts were also used to distinguish specific marked groups in 1979–80.

Ring codes could be read at distances of up to 200 m in good conditions and an attempt was made to resight as many as possible of the ringed birds, with details of breeding success and family associations, each season. Student and volunteer observers were in the field for most of the year and observations were made at several sites in winter, on staging islands in spring, and in part of the breeding area. Between October 1973 and May 1981 a total in excess of 41 000 sightings were made.

Population counts, probably accurate to within 1 or 2% were made in October each year, just after all birds had reached Caerlaverock. These and estimates of breeding success were used to calculate mortality of the population as a whole (see *Owen and Norderhaug*, 1977).

Results

Population totals and breeding success estimates over the period are given in Table 2. Overall population size increased almost three-fold in the 1970s and this could be explained without immigration provided overall mortality averaged about 10% per year, a considerable decrease from the average of 25% (*Owen and Norderhaug*, 1977) in the late 1960s, a time when numbers were relatively stable.

The number of birds surviving in October is plotted against the population in the previous October in Fig. 2. If mortality were density dependent, the number of survivors would be lower in proportion at high population levels, giving a curve resembling a logistic curve, with a plateau being reached when the population had expanded to the capacity of the food supply or some other resource. It is evident from Figure 1 that the mortality in this group has not yet, at least, density dependent. The winter food supply is adequate for a larger population and deaths from starvation are unknown during the period of this study. Without severe winters taking a toll (there has not been one during this study), the food supply is more likely to affect population size through recruitment (competition for food in spring enabling fewer birds to achieve breeding condition) rather than mortality.

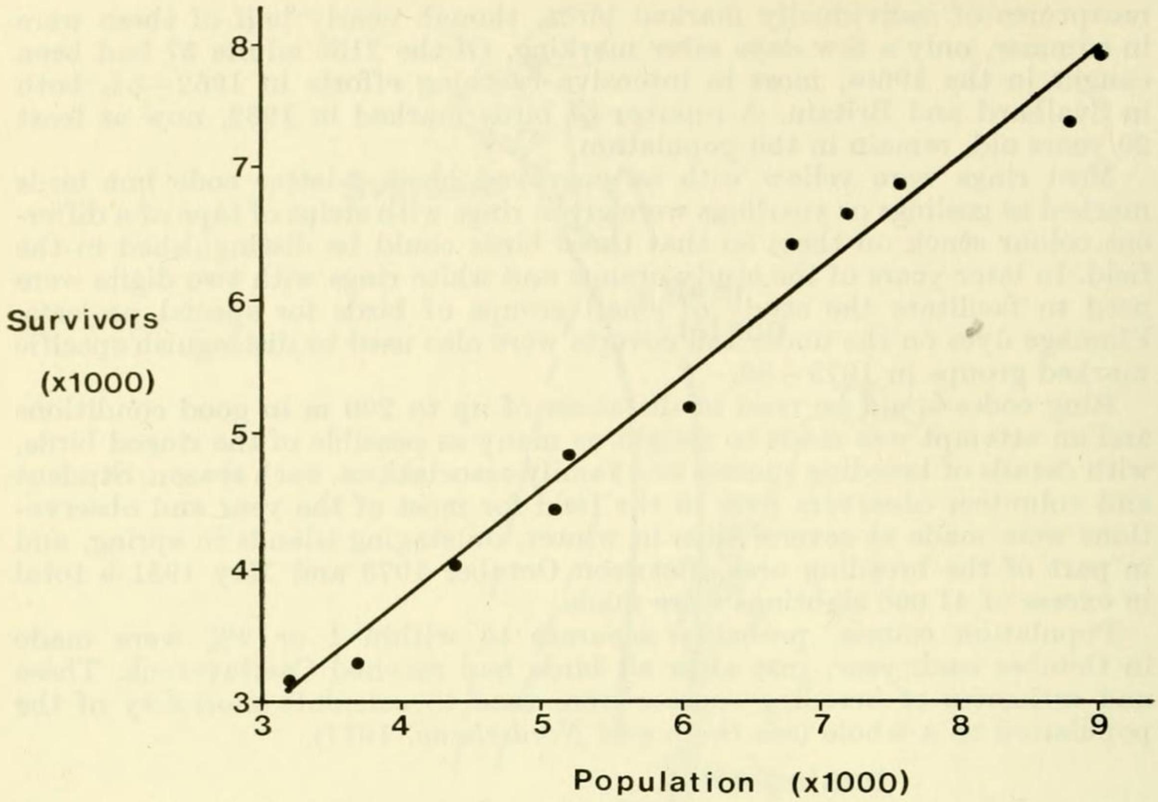

Figure XXVII/2: The relationship between the population in October 1971 to 1980 and the number surviving the following Oct. Correlation coefficient r = 0.991

Mortality estimates from ringed birds

If all individuals are accessible and have a high probability of being seen if alive, and the population is closed, the non-appearance of ringed birds can be taken to indicate their death. This population was considered closed by *Boyd* (1961) and although our intensive ringing has shown that a very few individuals do move to other groups, such movement is negligibe. In any case many of those misplaced birds find their way back to their native area and we have examples of a Greenland bird spending one winter on the Solway and then returning to its normal area, a bird from Siberian population doing likewise and a Svalbard-ringed goose spending a winter in the Netherlands and then returning to the Solway. Initial results were encouraging, with 342 out of 350 individuals (98%) ringed in 1973 being sighted subsequently on the Solway.

Another condition that must be met to make this method of estimating mortality effective is that ring loss must either be very small or must be accurately known on an annual basis. Most of our marked birds carried metal rings (monel in most cases) as well as plastic ones and ring loss could be examined in recaptured birds. A total of 499 individuals were re-caught (excluding same-summer recaptures) which had monel rings. The fate of the plastic rings and the number of days between capture and ringing are shown

Table XXVII/1.

Number of individual Barnacle Geese, excluding retraps and those whose rings were replaced, ringed with individually coded plastic rings, 1973 – 1981

Age and Sex*

	AM	AF	YM	YF	JM	JF	Total
July, 1973	177	173					359
October, 1975	41	32			19	25	117
October, 1976	48	37			27	36	142
July-August, 1977	379	335	179	291	19	25	138
October, 1977	61	80			7	11	159
January-May, 1978	99	193			4	6	212
October, 1978	84	81			72	75	312
July-August, 1979			13	14		11	38
Winter, 1979 – 80	74	86			21	14	195
Spring* summer, 1981	146	122	127	142		3	540
Sexed total	1109	1949	319	357	169	189	
Sex ration (% males)	51.4		47.0		46.2		
Grand total	2158		677		369		3293

*A = Adult, mainly of unknown age. In summer catches after 1973 adults are two years old or older, otherwise 1 year old or older

Y = Yearling, hatched about 13 months earlier

J = Juvenile, less than 12 months old

Sexing was always established locally.

Table XXVII/2.

Population data for Svalbard Barnacle Geese 1979 – 1981 including mortality estimates from counts and age ratio assessment

Year	Total number	% J	No.J.	N.R.*	% Mortality
1971	3799	15.9	559		
1972	4499	26.9	1149	449	11.9
1973	5199	21.9	1979	379	8.4
1974	5299	15.9	789	689	13.3
1975	6959	29.6	1259	499	7.7
1976	7299	28.9	2929	879	14.4
1977	6859	2.4	169	519	7.1
1978	8899	27.9	2299	349	5.9
1979	7799	3.6	289	1389	15.7
1980	9959	23.9	1859	799	9.1
1981	8399	3.2	279	1929	11.3

* = Non-Returns. Nr = previous yeares total-returning birds. (Returning birds are total no of juveniles.) This is expressed as % of previous years total to give % mortality. Counts are early October – arrival at Solway. Mortality therefore from 1 October to next.

in Table 3. The average time between capture and last recapture was 2.35 years so the loss rate of 0.4% over this period is equivalent to 0.14% per annum, or 2 – 3 individuals in the whole population. Breakages (usually loss of small pieces from ring edges) were slightly more common in older rings but there was no indication that breakages led to ring loss (neither of the birds whose rings were lost were reported to have broken rings previously and some birds had broken rings for a long period of time). However, we must assume that rings are more likely to be lost the longer they have been on the bird. The above analysis, however, does indicate that over a period of 4 – 5 years this loss is negligible in the population as a whole. Males were more likely to have lost or broken their rings than females. Twenty of the 26 were males (including birds whose rings were broken but had no metal rings hence not included in Table 3). The difference was highly significant when compared to the sex ratio of the ringed samples (Chi-square $p < 0.001$) but the reason is not clear.

The conditions of a closed population, accessibility and negligible ring loss have thus been satisfied and since the sighting rate is high (over 90% of ringed birds seen in the year after ringing) we can be confident in using non-appearance as an indication of death. With such a high resighting rate it is extremely unlikely that a bird which is present and ringed will be missed in two consecutive years. Such birds could be assumed fairly confidently to be dead and to have died in the season in which they were last seen. The season started on 20 September, the earliest date at which geese are seen on the Solway. Since the sighting rate in October and November is extremely high (more than 3/4 of existing birds seen) the assumption of death in the last year seen seems reasonable.

Of the 2139 birds examined for survival only 3 (0.14%) were missed for more than 1 year and later found to be alive so this method of estimating mortality is reliable. This allows us to assess accurately in retrospect the population of ringed birds at the start of each season and then to calculate the actual resighting rate of individuals in each season. The result of this analysis is given in Table 4.

Birds caught in early October are all included in the sample alive for that season. Slightly better resighting rates were obtained with tape on yellow

Table XXVII/3.

The status of 499 plastic rings examined on recapture (last recapture in the case of bird caught more than twice). Only birds also carrying metal rings included

Status	No.	%	Total days	Days/ring
Undamaged	476	95.4	488 982	1925.4
Worn or Broken*	21	4.2	29 115	1386.4
Lost	2	9.4	2 589	1299.9
Total	499		519 777	1941.6

* = These rings were replaced

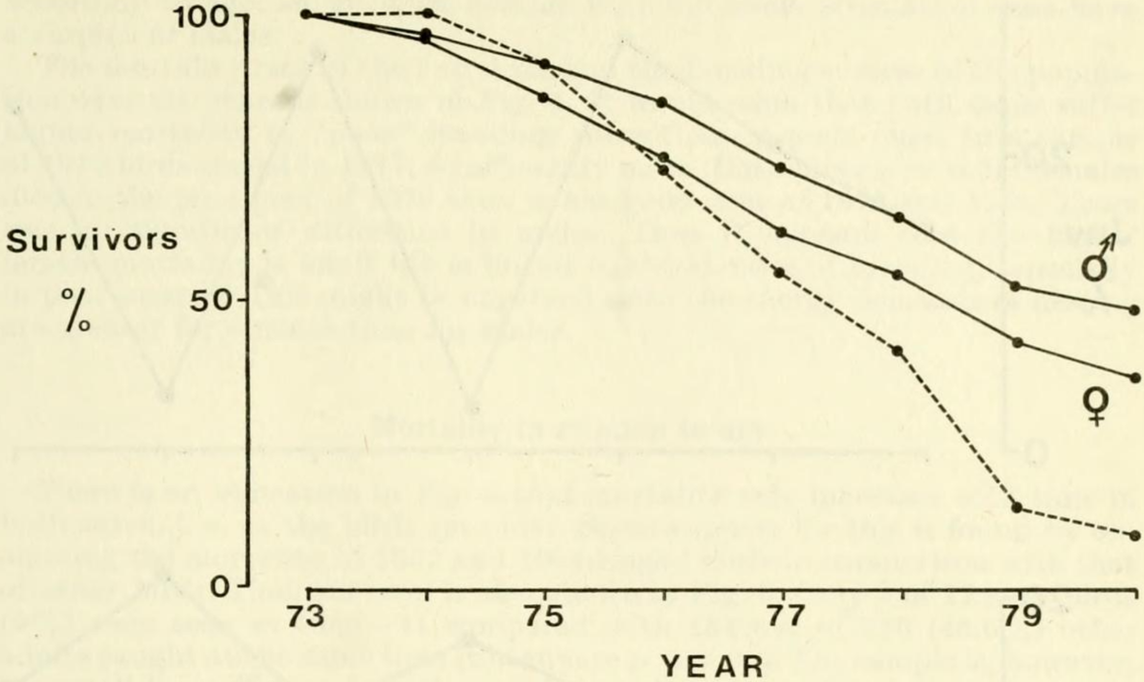

Figure XXVII/3: The survival of birds ringed in 1973 to 1980 – 81. Solid lines are males (upper, n = 171) and females (lower n = 171). Dotted line shows the survival rate of 22 birds caught at the same time but also ringed in 1962 – 1964. (at least 10 years old in 1973)

rings and orange rings with plumage dyes produced a rate of 99.2% (n = 241) in 1979 – 80.

Overall, the resighting rate is very high, and the probability of birds being missed in 2 consecutive years was 0.42%, higher than that actually found. The time spent monitoring ringed birds increased markedly after 1977 when the number of marked individuals increased so that the resighting rate suffered little.

Mortality in relation to sex

Sex-related mortality was studied by examining the survival of the 343 adults ringed in 1973 and alive in the following autumn. The result is shown in Fig. 2. Males were significantly more likely to survive (45%) than females (34.5%) to 1980 – 81 (Chi square test $p < 0.05$). The time between ringing and "death" was calculated by assuming that birds that had died in the first season had survived 0.5 years, in the second 1.5 years etc. Dead females had survived, on average, 3.56 years and males 3.8 years after ringing. This could not be explained by ring loss (see above). *Owen et al.* (1978) found significantly more males in the adult sample caught in summer 1977 and suggested a higher female mortality related to the rigours of breeding. In the overall sample (Table 1) no age group shows a significant deviation from a 1:1 ratio but there are significantly more males (51.3%) in the adult sample than in that of immatures (47.2%). Chi square $p < 0.02$. There is no evidence to suggest sex bias in any catching method and cloacal sexing is not biased

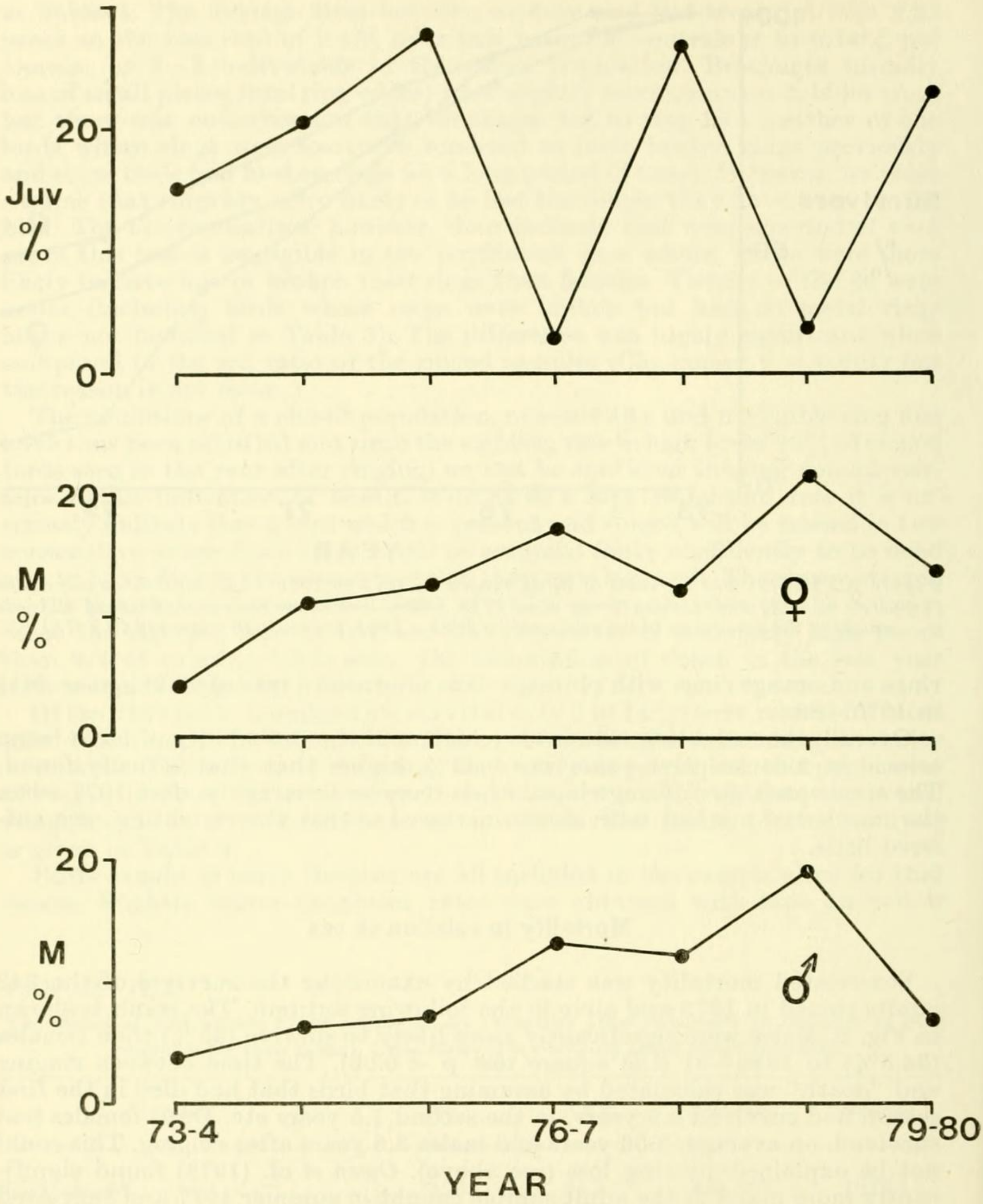

Figure XXVII/4: The breeding success of the population (top) and the % mortality of females (central) and males (bottom) in the same seasons according to age, so we must assume that the adult population does have a surplus of males.

The mortality rate of the two sexes and the breeding success of the population over six years is shown in Fig. 4. It would seem that both sexes suffer higher mortality in "poor" breeding years than in good ones. In a sample of 1012 birds ringed in 1977, significantly more (Chi square $p < 0.01$) females died in the poor year of 1979 than in the good ones of 1978 and 1980. There was no significant difference in males. Thus it appears that the higher female mortality is adult life is linked to the stresses of breeding, especially in poor seasons. This might be expected since the energy demands of nesting are greater for females than for males.

Mortality in relation to age

There is an indication in Fig. 4 that mortality rate increases with time in both sexes, i. e. as the birds get older. Some support for this is found by examining the mortality of 1962 and 1964-ringed birds in comparison with that of other birds. Their survival is also shown in Fig. 3. Only 2 of 22 such birds (9%) were seen in 1980–81 compared with 134 out of 330 (40.6%) other adults caught at the same time (Chi square $p < 0.05$). The sample is, however, too small to verify the hypothesis.

Too few juveniles have been ringed on the breeding grounds to enable an estimation of mortality on autumn migration to be made. *Owen and Norderhaug* (1977) estimated this to be less than 15%. Data collected on family size during this study suggest that losses between fledging and arrival at the wintering grounds are of this order. Juvenile mortality in the year after arrival has been estimated for five seasons and is shown in Fig. 5, together with the adult (including yearling) mortality in the same seasons. So that ring loss does not affect the picture adults were restricted to those ringed one or two years previously. Unfortunately few juveniles were caught in most

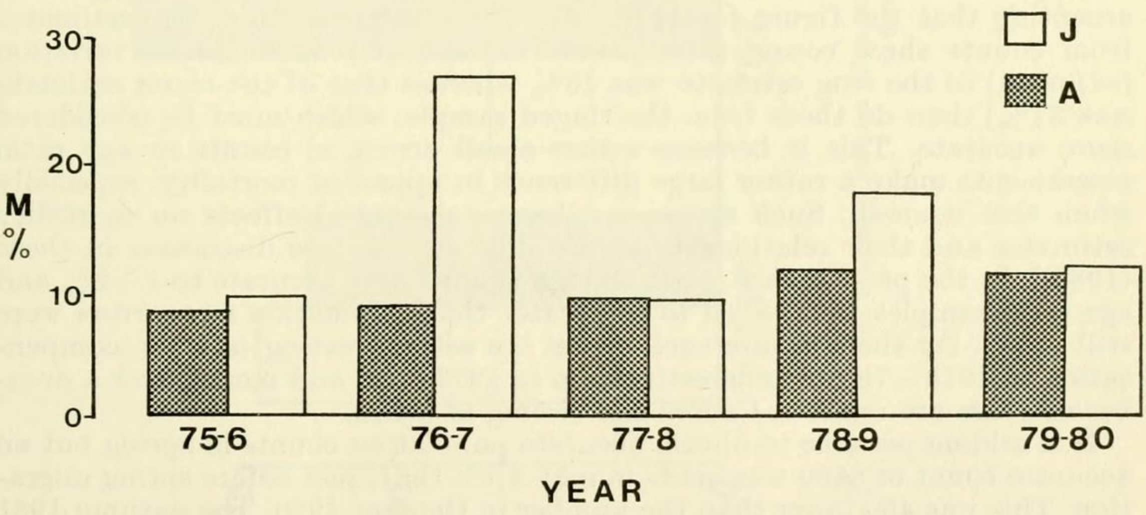

Figure XXVII/5: The mortality rates of adults and juveniles in five different seasons. Differences were significant in 1976 – 77 and 1978 – 79 only, though 1976 – 77 juvenile rate is thought to be an overestimate (see text) years but the results do indicate only slightly higher mortality in the first year than in adult life. Juvenile mortality was significantly greater in 1976–77 ($p < 0.001$) and in 1979–80 ($p < 0.05$). The sample was small in 1976–7 however and there are indications that juvenile mortality was overestimated (see below). Both these years were good breeding seasons and it has often been suggested that juvenile mortality is higher in good breeding seasons because the birds are more mobile and more vulnerable to shooting when the young proportion is high. Overall adult mortality rate in this sample was 11.5% (mean of annual means, compared with 16.8% for juveniles).

Losses in the second season, when the birds do not breed but are still rather inexperienced, were also examined. In no individual season was yearling mortality significantly different from that of comparable adults (ringed in the same catches). On average second year mortality was 8.3% ($n = 650$) and comparable adult losses 9.9% ($n = 1545$); the difference is not significant. Thus for comparison with other age classes yearlings can be included with adults. This result might have been expected since yearlings achieve adult weight by the second winter (*Owen and Ogilvie*, 1979) and their lack of experience is compensated for by the fact that many (probably most) do not go through a full breeding cycle.

Mortality estimates from rings vs. counts

Given a knowledge of adult and juvenile mortality and the age ratio of the population it is possible to estimate the overall population mortality from the ringing data. These estimates are compared in Fig. 6 over the 5 seasons from which data are available. There is a large disparity between the two estimates in 1976–77, largely attributable to the very high estimate of juvenile mortality in that year. This is added support for the suggestion that this estimate, based as it was on a small sample, was too high. In three out of the five years the correspondence between the two estimates is good and the average for all years was 10.4% (counts) and 13.0% (rings). In general, accepting that the figure for 1976–77 is too high, the mortality estimates from counts show considerably more variability [coefficient of variation (sd/mean) of the ring estimate was 16% whereas that of the count estimate was 37%] than do those from the ringed sample, which must be considered more accurate. This is because rather small errors in counts or age ratio assessments make a rather large difference in apparent mortality, especially when this is small. Such errors can have substantial effects on mortality estimates and their relationship to breeding success [see discussion in *Owen* (1980)]. In the present case, even though counts were accurate to 1–2% and age ratio samples were equal to or greater than population size, errors were still made. By their nature such errors are self-correcting (see e.g. compensation in 1978–79 for underestimation in 1977–78) and means over a number of years are reliable. Causes and timing of losses.

It is seldom possible to obtain accurate population counts in spring but an accurate count of 8600 was made in mid April 1981, just before spring migration. This was 450 lower than the number in October 1980. The autumn 1981 total was 8300, including 270 (3.7%) juveniles. Thus 470 geese which left the Solway in April failed to return. This means that about half the annual

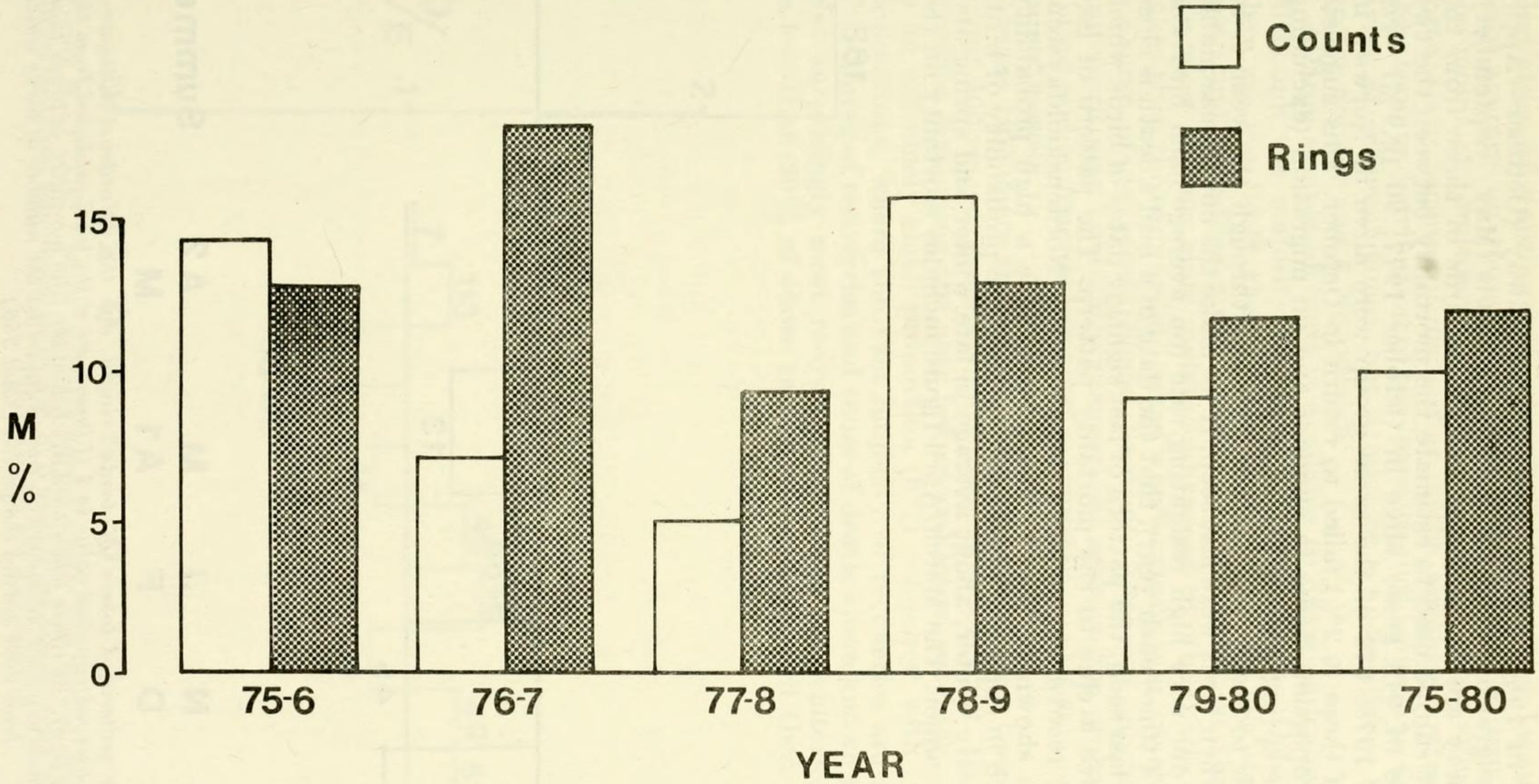

Figure XXVII/6: The mortality rate as estimated from counts and age rations (open) and ringing (shaded colums). 1975 – 80 average is based on all losses, not a mean of annual rates mortality of 11.3% in 1980–81 occurred on the Solway (October–April) and half either on migration or on the breeding grounds (May–September).

Sightings in Norway are an unbiased sample of birds of those from the Solway and this fact can be used to estimate the mortality between the two places. Of a sample of 912 geese alive in October 1977, 90 (9.9%) were "dead" by October 1978. 372 of the same group were alive in Norway in May 1978 and 23 of these (6.2%) failed to return in October. This suggests a slightly higher proportion dying in summer and on migration (excluding the first stage of the spring journey) than in winter.

Another approach to study the pattern of losses through the year is to examine the dates when birds were last seen. If we make the not unreasonable assumption, giving our very high resighting rate (on average each bird was seen between 3 and 4 times each year), that the date of a bird's death is close to that when it was last seen, the pattern of last sighting dates of birds which have "died" will give a clue to the mortality pattern. The pattern of last sightings (including recoveries) of birds ringed on the Nordenskioldkysten, Svalbard in 1977 is shown in Fig. 7. These birds have a high probability of being sighted both in summer, winter and spring. The probability of birds dying is lowest in early winter, about average in late winter and spring and extremely high in summer. The March/April figure includes mortality on the

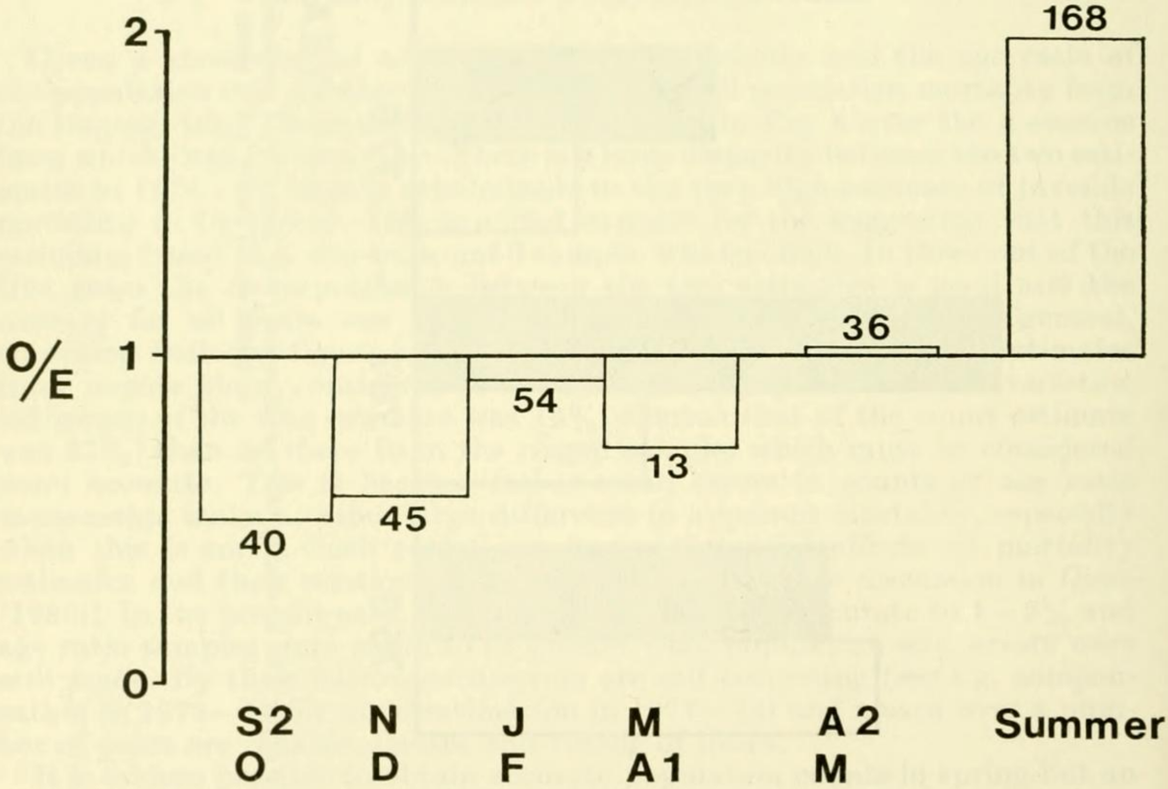

Figure XXVII/7: The pattern of losses of birds ringed on the Nordenskioldkysten, Svalbard in 1977. The observed/expected value is 1 if losses are at the level predicted from the pattern of sightings (see text). At times when bars are below the line mortality is lower than expected, above, higher than expected. Numbers on each column are the number of birds which have died during the period (total 356) first stage of a spring migration (1600 km), where losses are very low, and only average on the second stage (1600 km). The summer value includes the moult and autumn migration, two of the most vulnerable periods. Unfortunately because of disparities in the resighting rates at different times the absolute distribution of the losses cannot be used to assess the proportion dying at different times, but it may be no coincidence that 4.3% occurred on the Solway and 5.7% outside.

A large sample of birds is available to examine losses in winter (Fig. 8). Although the majority of birds disappear during October and November they are less licely than predicted to do so. At this time they are largely restricted to refuge areas and move very little. As the winter progresses the geese become more mobile and spread to other parts of the Solway. This takes then through or into areas where other geese are shot and there is also a degree of deliberate illegal hunting. Apparent mortality in late March and April may be slightly exaggerated because the probability of sighting in spring and summer is less than in winter (i. e. this sample may include some sumer losses).

Since 1977 more than 20% of the population has been carrying rings and about 700 ringed geese died between 1977 and 1981. However, only 60 recoveries (excluding the very few casualties in catching) were reported. This is an extremely small proportion (9%) compared with those in other goose populations, where the vast majority of recoveries are from legal hunting. The timing of recoveries and cause of death where known are given in Table 5. Not surprisingly most recoveries are from the wintering grounds but this is less than 20% of those calculated to have died there (at least 600 since

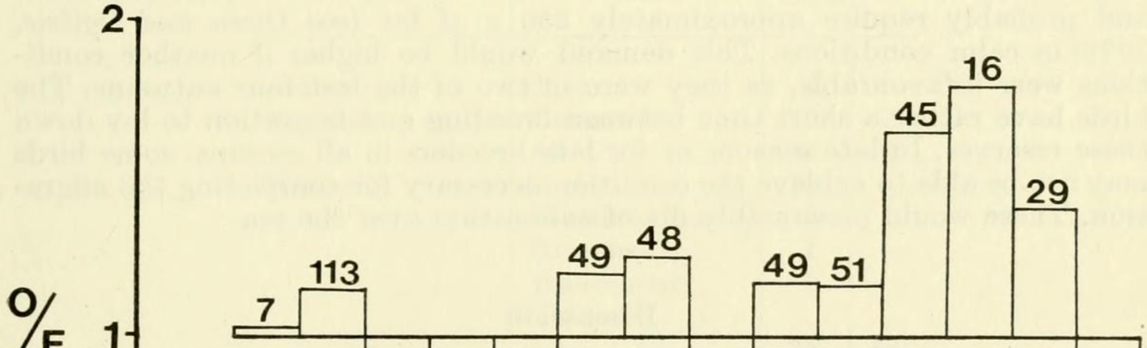

Figure XXVII/8: Pattern of losses during winter and spring using the whole sample of ringed birds and constructed as in Fig. 6. Numbers are sample sizes of dead birds (Total 604). Time periods are half-months

1973 – see Fig. 8). A large proportion are also found on autumn migration, confirming that this is a hazardous time for the geese.

There are very few recoveries from the breeding grounds despite the fact that a team of observers has spent each summer 1978 – 81 on the Nordenskiold coast, where an average of 800 – 1000 ringed geese have summered. Fox kills may have been buried but many kills of other birds are found and fox predation probably accounts for rather few birds. The low level of recovery in spring, where the route is similar to that in autumn, and where the geese stop for 2 or 3 weeks in Norway, suggests rather few deaths then. We must conclude therefore that mortality both in spring and summer is rather low.

Shooting is still a surprisingly important mortality factor although the geese have been protected throughout their range since 1961. Of 83 adults X rayed in 1975 and 1976, 20 (24%) carried lead shot in their tissues indicating that they had been shot at some time. This is a remarkably high level and since there is little shooting in Norway or in Svalbard, most of this occurs on the Solway, or in other parts of Britain during autumn migration. In a legitimate quarry species such as the Pink-footed Goose *Anser brachyrhynchus* at a time when shooting was heavier than it is today, the level was only 41% (*Elder*, 1955). Most of the geese that were reported to have died on the Solway of unknown causes were found during the shooting season on areas where shooting was allowed.

The low summer mortality rate suggested by this analys is of recoveries apparently conflicts both with the high rate demonstrated in Fig. 7 and the suggested higher female mortality due to losses related to breeding. The estimate in Fig. 7 does, however, include autumn migration losses and breeding stress could well not cause actual deaths until the autumn. The autumn migration, from a staging area on Bear Island is usually non-stop (cca 2500 km) and probably require approximately 250 g of fat (see *Owen and Ogilvie*, 1979) in calm conditions. This demand would be higher if weather conditions were infavourable, as they were in two of the last four autumns. The birds have rather a short time between breeding and migration to lay down these reserves. In late seasons or for late breeders in all seasons, some birds may not be able to achieve the condition necessary for completing the migration. These would presumably die of exhaustion over the sea.

Discussion

Mortality in goose populations is usually estimated either by counting and age ratio assessment of from ringing recoveries. The method described here is unique for a migratory population and provides an opportunity of examining mortality in more detail than has hitherto been possible. The errors involved in the method are small in comparison with other studies as long as ring loss remains slight.

Despite this a significantly higher mortality rate over a long period was demonstrated for females. This is an unique finding in geese, where males are usually reported as surviving less well than females. *Vaught and Kirsch* (1966) found higher overall mortality of males in eastern prairie Canada Geese *Branta canadensis* but suggested that females had higher natural mortality causes linked to breeding stresses. *Imber* (1968), however, disputed

Table XXVII/4.

The resighting rate in the following 12 months of a sample of ringed individuals (birds ringed after October not included, plain yellow rings only) known to be alive at the beginning of each season (September 29)

Season	No. alive	No. seen	Resighting rate
1973 – 74	342	328	95.9
1974 – 75	329	312	94.8
1975 – 76	373	356	95.4
1976 – 77	429	395	94.9
1977 – 78	1467	1498	96.9
1978 – 79	1668	1597	99.3
1979 – 80	1440	1349	93.1
1980 – 81*	229	214	93.4
Overall	6268	5869	93.49

* = The sample in this season is a group of birds recaptured in July 1981 and does not include the whole year. The effect is, however likely to be only a slight understimate of resighting rate.

Table XXVII/5.

Timing of recoveries and cause of death of recovered birds where known, 1973 – 81

Time	Cause	No.	%
Autumn	Shot	8	
migration	Unknown	7	
	All	15	25
Winter	Shot	12	
	Caught in line	2	
	Hit wires	1	
	Tuberculosis	1	
	Unknown		
	All	35	58
Spring migr.	Shot	1	
	Hit wires	1	
	Unknown	1	
	All	3	5
Breeding grounds	Killed by fox	2	
	Unknown	5	
	All	7	12

Cause of death where known

Shot	21(75 %)
Accidents	4(14 %)
Fox pred.	2(7 %)
Disease	1(1 %)

their evidence and showed that natural mortality of male Canada Geese in New Zealand was higher than that of females. In hunted populations it has been established that males are more vulnerable to shooting because of their larger size and leadership in flights and this affects overall survival. In this study, despite the fact that illegal hunting accounts for a large proportion of deaths female mortality is higher and this has resulted in an excess of males in the adult population.

First year mortality was 1.4 times as high, on average, than that of adults. This is lower than the disparity found in many other populations. *Boyd* (1976) found that young Lesser Snow Geese *(Anser caerulescens)* had a mortality rate 2.4 times as high as that of adults and the figure for Canada Geese was 1.63 (*Chapman et al.*, 1969) and 1.8 (*Vaught and Kirsch*, 1966). In the introduced non-migratory and largely unshot Canada Geese in Britain first year mortality is only 1.05 times as high as adults (*Thomas*,1977). Higher vulnerability to shooting, especially when decoys are used, is responsible for differential mortality in hunted populations.

Juvenile mortality is extremely low for a bird population and the family behaviour of geese and swans does serve to enhance the survival of the young by providing them with favourable feeding opportunities (*Scott*, 1978, *Owen*, 1968). Juveniles could suffer in a situation such as that described by *R. B. Owen* (pers. comm.) in Atlantic Brant Branta bernicla. Hard weather reduced food supplies early in the winter of 1976 – 77 and most juveniles succumbed, probably because they had not enough time to build up energy reserves equivalent to those of adults.

The mortality of birds in their second year was slightly lower, though not significantly, than that of adults. This is not surprising since yearlings achieve adult body weight in their second autumn (*Ower and Ogilvie*, 1979). There was a suggestion of an increase in mortality in old age. This is very difficult to demonstrate but future studies will enable this hypothesis to be more fully tested.

A comparison between mortality estimates from counts and more accurate ones from ringing indicate that, as expected those from counts are more variable but self-compensating. This means that estimates over a period of years give very close results. Annual variations in mortality using the count method must be treated with extreme caution since not only are they dependent on the accuracy of counts but also on that of age ratio assessment. Both of these can be biased and the bias correlated with breeding success to lead to spurious conclusions on mortality in relation to recruitement.

Just over half the mortality in this population occurs outside the wintering area and the evidence also suggests rather few losses on the breeding grounds. Autumn migration seems to be a crucial time because the long non-stop journey necessitates a large store of fat to be available. I suggest that this may not be possible for some individuals to accumulate especially in late years and that females suffer more heavily because of their higher energetic deficit following laying and incubation. The weights of post-breeding female Lesser Snow Geese is only 76% that of males compared to 195% prebreeding (*Ankney*, 1977; *Ankney and MacInnes*, 1978) and 94% in winter (*Flickinger and Bolen*, 1979). This also explains the significantly higher female mortality in bad as opposed to good breeding years.

It is surprising that shooting on the Solway makes such a large contribution, accounting for 30 – 40% of all losses. As the population has increased in size the birds have moved outside refuges more regularly and in larger numbers making them accessible to accidental and deliberate illegal shooting. Mortality in the 1960s was apparently as high as 25%. Why has it declined in the 1970s? It can hardly be argued that losses in summer and on migration have decreased. Three of the last five years have been worse for breeding than any of the previous 19 and conditions on autumn migration have been very severe in recent years. There was a small amount of legal shooting in Svalbard prior to 1968 but since the majority of the range is not readily accessible to humans, this probably had a negligible effect. Most of the difference must therefore be explained by changes on the wintering grounds. There has been no evidence, either from counts or from direct observation, of large losses due to severe weather. There has probably been a decline in illegal hunting pressure due to better education and hunting practices. The birds were also less accessible to shooters in the 1970s due to the approximate doubling of the size of the sanctuary area in 1970 when the Wildfowl Trust leased and bought farmland at Caerlaverock and managed it for the geese.

This study provides information on mortality (and recruitment which has not been discussed here) very much more accurate and sensitive than that available to most workers. There is probably not other migratory goose population in the world which provides such good conditions for such an investigation. The value of this kind of long term study does not diminish with time, indeed information impossible to obtain in other ways on age related mortality and breeding success, important in population modelling and management, can only be obtained from such a study. In order that the importance of ring loss with age of rings can be assessed and in order to monitor the population through a range of wintering and breeding conditions, the ringing programme must be continued. The population will at some time, presumably, stop growing and it would then be highly desirable still to be active in this kind of detailed monitoring to find out the exact mechanism by which stability is achieved.

Acknowledgements

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Summary

This paper is a progress report on a long term population study of a closed group of Barnacle Geese breeding in Svalbard and wintering in northern Britain.

A total of 2158 adults, 676 yearlings and 369 juveniles were marked with coded rings readable in the field at 200 m between 1973 and 1981, and more than 20% of the population was individually marked from 1977 onwards. The population increased from 3700 in October 1971 to a maximum of 9050 in October 1981, despite three disastrous breeding seasons, in 1977, 1979, and in 1981, when the total fell to 8300.

Only 2 of 499 rings (0.4%) were lost by birds recaptured on average 2.85 years later, giving an annual rate of 0.14%. Resighting rate of birds alive and carrying rings was on average 93.5% annually; this high level allowed mortality estimates to be made by assuming birds were dead if they were not seen in two successive years. They were assumed to have died in the year in which they were last seen.

A significantly higher proportion of females than of males ringed in 1973 had died before 1981 and those that had died had done so sooner than had males. It was suggested that this was a result of the greater energetic demands on the female during the breeding season. Both sexes showed higher mortality in poor than in good breeding seasons but the difference was only significant in females.

Juvenile mortality was similar to that of adults in three of five years and significantly higher in two. Mean adult mortality was 11.5% compared with 16.8% for juveniles. Losses in the second year of life were similar to those of adults. Birds ringed as adults in 1973 showed higher mortality rates as time progressed. A group of 22 geese caught then and also ringed as adults in 1962 – 64 had significantly higher chance of having died before 1981 than the others (9% survived compared with 41%), suggesting higher mortality rates in older birds.

Mortality estimates from ringed birds were similar to those determined by the more traditional method of counting and assessing age ratios but variability was less than by the latter method. This was due to errors in the count/ratio estimates, which, although reliable when averaged over a period of years, should not be used to examine annual variations in mortality.

Between 40% and 50% of the mortality occurred on the wintering grounds and the vast majority of deaths there were from illegal shooting. Losses were lower than expected early in the winter and increased as the geese progressively moved away from sanctuary areas. The mortality drop between the 1960s and 1970s which was responsible for the population growth, was probably due to an increase in the size of sanctuary areas and stricter control of shooting.

Of the remaining losses few were on spring migration and recoveries from the breeding grounds were also few. The hypothesis is put forward that energy demands of breeding, especially in poor years, cannot be sufficiently replenished to complete the long over-sea autumn migration. This would result in some birds dying of exhaustion over the sea.

The methods described here are accurate and sensitive but cannot be applied to many larger or more mobile groups of geese. It is vital to continue this

study as a long term project since it provides unique information on population behaviour.

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XXVIII. THE IMPORTANCE OF SPRING STAGING AREAS FOR ARCTIC-BREEDING GEESE, WINTERING IN WESTERN EUROPE

B. Ebbinge – A. St. Joseph – P. Prokosch – B. Spaans

In justifying the need to safeguard wintering and spring staging areas for migratory geese, the argument that the condition the geese build up in these areas is of vital importance to their subsequent breeding success, is heard more and more among conservationists.

Examining the value of this argument, we discern two questions:

– is it true that geese can only breed in the Arctic if they have built up sufficient body reserves elsewhere?

– if so, where and when do they build up these necessary reserves?

1. The condition hypothesis

1.1 Introduction

The hypothesis that female condition on arrival in the breeding area determines her breeding success has been advanced by several investigators (*Ryder*, 1967; *Harvey*, 1971; *Newton* 1977; *Prop et al.*, 1978). This condition hypothesis could be tested by measuring the condition of individual birds upon arrival in the Arctic and the subsequent breeding performance of these same birds.

So far, only indirect evidence has been accumulated. Positive correlations between mild weather on the wintering grounds and subsequent breeding success in the Arctic have been demonstrated for Barnacle Geese *(Branta leucopsis)* wintering in Ireland (*Cabot* & *West*, 1973) and Whooper Swans *(Cygnus cygnus)* wintering in southern Sweden (*Nilsson*, 1979).

Monitoring Lesser Snow Geese *(Anser caerulescens caerulescens)* at various stages throughout the Arctic summer Ankey & *MacInnes* (1978), summarized in (*Drent* & *Daan*, 1980) revealed that:

– upon arrival on the breeding grounds the geese are heavier than at any other time of the year,

– heavier females would have laid larger clutches,

– during early incubation, weights of females with completed clutches are strikingly similar, even though clutch sizes vary from 2 to 6 eggs,

– the breakdown of both fat and protein reserves results in a 42% weight loss in breeding females at the time of hatching. At that time failed nesters have even lower weights than those whose clutches are about to hatch.

Since in this latter study neither the weights (and therefore condition) at the onset of breeding of failed breeders nor those of successful ones are known, it is not possible to conclude from these data that the initial body condition of a female goose determines its subsequent breeding performance. Rather, because the weights after laying were so similar, one would favour the explanation that female geese differ in the rate at which they spend their body reserves during incubation. A more subtle approach has been adopted by Lessells & Owen, who used weigh-bridges placed under the nest both in captive Barnacle Geese *(Branta leucopsis)* and in wild Lesser Snow Geese (*Anser c. caerulescens*). In both species similar proportional weight losses were registered in breeding females as those found by *Ankney* & *MacInnes* (*Lessells et al.*, 1979, *Owen*, 1980). However, due to the amount of work involved per nest, this method has not yielded sufficient data to test the condition hypothesis yet.

Recognizing that the Wadden Sea area in western Europe is the only spring staging area for Dark-beilled Brent Geese *(Branta bernicla bernicla)*, and that upon return from the breeding grounds in the autumn the breeding success of individual geese can be assessed because parents are accompanied by their recent offspring, we decided to test the condition hypothesis without bothering to go to the Arctic at all.

Brent Geese stay in the Wadden area until late May, feeding on the spring growth on the saltmarshes and thus increasing their body weight from 1250 to 1600 grams on average, in about a month (*St. Joseph et al.*, in prep.). Then they leave on an almost non-stop flight for their breeding grounds in Taymyr, Arctic Siberia. We adopted two different approaches to investigate the condition hypothesis:

– comparing reproductive performance to individual body weight at the point of departure the spring staging areas,

– comparing the mean rate of weight increment in spring to the mean reproductive performance of the whole population.

1.2. Methods

Our first approach consisted of cannon netting Brent Geese as close as possible to the date of departure from the Wadden area in spring. Usually mass departure takes place from 20 – 28 May. The birds caught were measured, weighed, sexed and fitted on each leg with a large plastic ring, each one carrying a single letter or number engraved three times round it for easy observation.

This marking method, developed by St. Joseph, gave a series of individual combinations which could be read through telescopes at distances of up to 300 metres.

In this way we were able to mark 89 adult females in the period 1976 – 1979. The next autumn we tried to spot as many as possible of the birds marked the previous spring, and noted whether they were accompanied by young or not.

Secondly, we caught Brent Geese somewhat earlier in the spring, and two or more catches in the same spring allowed us to calculate the regression of body weight on time in the spring of 1977, 1978 and 1979. These were then compared to the overall breeding success the following autumn.

1.3. Results

Breeding success turned out to be very poor in 1976 (11.6% juveniles in the autumn) and 1977 (0.01% juveniles). None of our marked birds was accompanied by any offspring the following autumn (see Table 1). With a mean proportion of juveniles of 35% and 33% respectively, 1978 and 1979 were good breeding seasons. In these years a third of the previously marked females was spotted in the autumn and their family size assessed (Table 1). Because the separate samples were too small, we had to combine the 1978 and 1979 samples. In order to compare the weight from these three different catches, weights were adjusted to the level of the 23 May 1978 catch, being the most advanced in the season.

We did this by adding the difference between the means of the catches to the weights of the individual birds concerned. Thus 100 grams was added to the weights of birds resighted from the 18 May 1978 catch and 25 grams to those from the 17 May 1979 catch (See Table 1).

The combined samples (see Fig. 1) indicate that in good breeding seasons the heavier females are more often successful, the mean spring weight of successful females being significantly higher than that of ailed breeders ($p = 0.02$; one-tailed t-test). To find out whether being heavier in spring was simply a result of body size, wing length of successful females were also compared to those of unsuccessful ones, but no significant difference emerged (see Fig. 1). From this we conclude that attaining a heavier spring weight must be due to other factors such as a better feeding technique, or better feeding conditions resulting from better protection against conspecifics by its mate during spring fattening as in the Common Eider (Somateria mollissima) (*Ashcroft*, 1976).

The results of our second approach are given in Fig. 2. The slope of the regression line and thus the rate of body weight increment in 1977 is significantly lower ($p = 0.1$) than in the other two seasons. Accordingly 1977 turned out to be a non-breeding year for these Brent Geese, whereas the other two years were good breeding years (see above, and Fig. 2). We are still very much

Table XXVIII/1.

Numbers of adult female Brent Geese marked at the point of departure from the spring staging areas, and the number resighted the following autumn

Number caught			Number resighted		
date	mean weight			–	+
21 – 5 – 76	25	1585 grams	11	11	0
21 – 5 – 77	22	1450 grams	10	10	0
18 – 5 – 78	17	1458 grams	7	4	3
23 – 5 – 78	12	1560 grams	4	2	2
17 – 5 – 79	13	1535 grams	4	2	2

– returning without offspring
+ returning with offspring

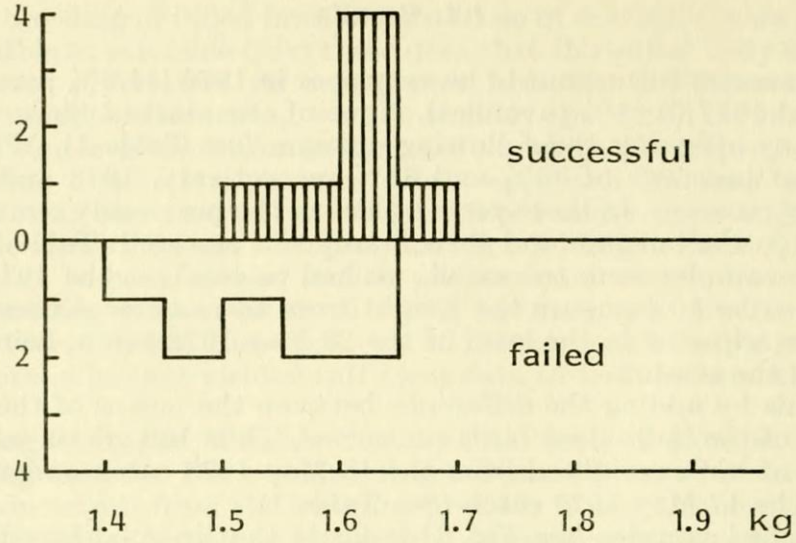

Figure XXVIII/1: Breeding success and spring departure weights in adult female B. b. bernicla. The mean spring weight of successful females (1618 grams, n = 7) differed significantly from that of failed breeders (1536 grams, n = 8) (p = 0.02, t = test). Mean wing lengths of both groups (332 mm against 334) did not differ significantly (t test)

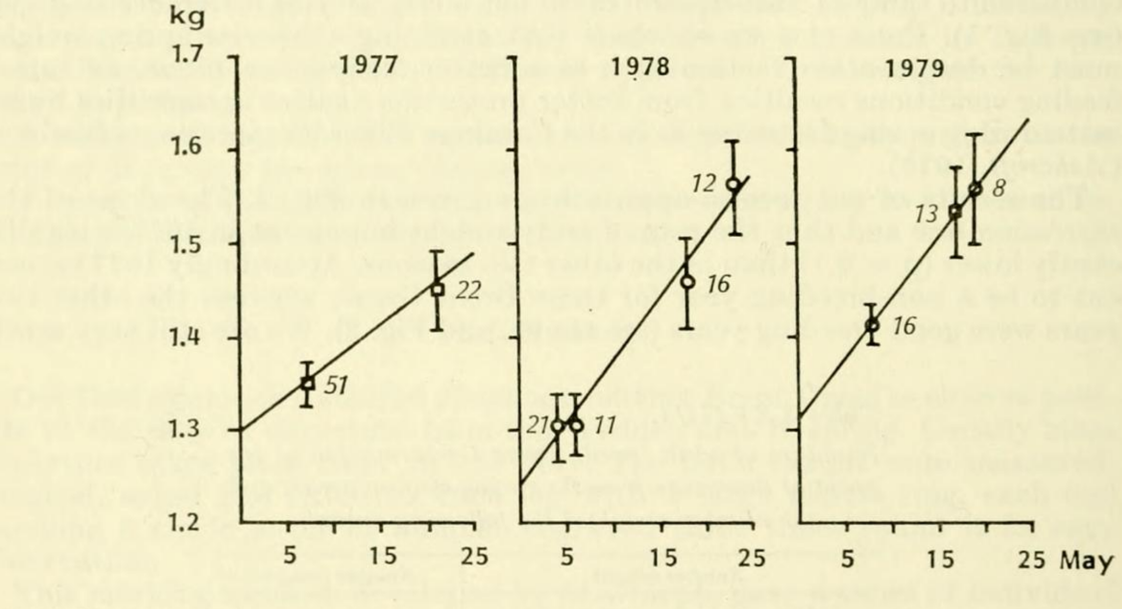

Figure XXVIII/2: Rate of increase in body weight in adult female B. b. bernicla in May in three years with the subsequent breeding success of the whole population. Squares are samples from the Dutch part of the Wadden Sea, and circles from the German Wadden Sea. These symbols indicate the mean, whereas vertical bars indicate the 95% confidence interval. Numbers indicate sample size. The slope of the regression line in 1977 differs significantly from that in 1978 (p.= 0.005) and 1979 (p = 0.01), but the slopes of 1978 and 1979 do not differ significantly (p = 9.005, t test) in the dark as to the cause of this reduced rate of body weight increment in 1977. *Ebbinge* (1977) suggested strong winds as a possible factor reducing intake of food, or resulting in a higher energy expenditure to maintain body temperature.

2. The spring staging areas

2.1. Introduction

Our second question as to when and where the apparently important body condition is built up, will be treated in this section.

Since a positive correlation between winter temperature and subsequent breeding success was found in two studies (*Cabot* & *West*, 1973; *Nilsson*, 1979), one might think that achieving the right breeding condition is a rather slow process continuing through the winter.

However, data on annual fluctuations in body weight in Brent Geese *(Branta bernicla bernicla)* (*St. Joseph et al.*, in prep.) and Lesser Snow Geese (summarized by *Owen*, 1980) show that the lowest weights occur shortly after the winter is over. This finding made it more likely that spring feeding conditions in themselves determine whether sufficient body reserves can be accumulated, irrespective of feeding conditions in the preceding winter.

Virtually the entire dark-bellied Brent Goose population *(Branta bernicla bernicla)* is concentrated in the Wadden area (*St. Joseph*, 1979) throughout the spring (April – May). To find out whether other Arctic-breeding goose species were concentrated on special spring staging areas too, we analyzed the available ringing recoveries of Barnacle Geese *(Branta leucopsis)*, White-fronted Geese *(Anser albifrons)* and Bean Geese *(Anser fabalis)* ringed in the Netherlands.

2.2 Method

We restricted the analysis to shot birds, to avoid any bias inherent in the category of birds "found dead".

The analysis covers the period 1955 – 1978, but the majority of our material stems from the sixties. In the fifties very few birds were ringed, and in the seventies spring hunting in the U.S.S.R. was no longer permitted (*Rutschke*, 1976). We grouped the recoveries in five 10-day periods (decades) from 10 April until the end of May.

Because the last two periods included many recoveries from the breeding grounds, these were combined.

One duck species, the Wigeon (Anas penelope), was included in the analysis, because, ecologically speaking, it is the "goose" among the ducks. For each species and each period the mean position was calculated. The significance of the differences between these mean positions was tested using the Mardia test ($p < 0.05$, *Mardia*, 1972).

2.3 Results

In Table 2 the mean positions (in tenths of degrees) are given for all different species and periods except the Barnacle Goose *(Branta leucopsis)*. Too view recoveries of the latter species were available to calculate its mean positon in all ten-day periods. From recent counts (*Ebbinge*, 1981) we know that the entire Russian population of this species from mid-April to mid-May is concentrated in the Baltic in Gotland and in the Estonian S.S.R.

This is in agreement with the six recoveries of Branta leucopsis in mid-spring (20 – 30 April) (see Fig. 3).

In Fig. 3 the actual distribution of the recoveries of all four species in mid-spring is depicted.

It is obvious that in spring all goose species are virtually separated from each other. Only White-fronts *(Anser albifrons)* and Wigeon *(Anas penelope)* overlap during one ten-day period (20 – 30 April).

Whereas both Branta species stay the entire spring period within a well defined area, the data on the other species (Table 2) indicates a gradual shift in a northeastward direction.

This gradual shift to the north while accumulating body reserves is apparently also typical in Lesser Snow Geese *(Anser c. caerulescens)* staging at James Bay (*Wypkema* & *Ankney*, 1979).

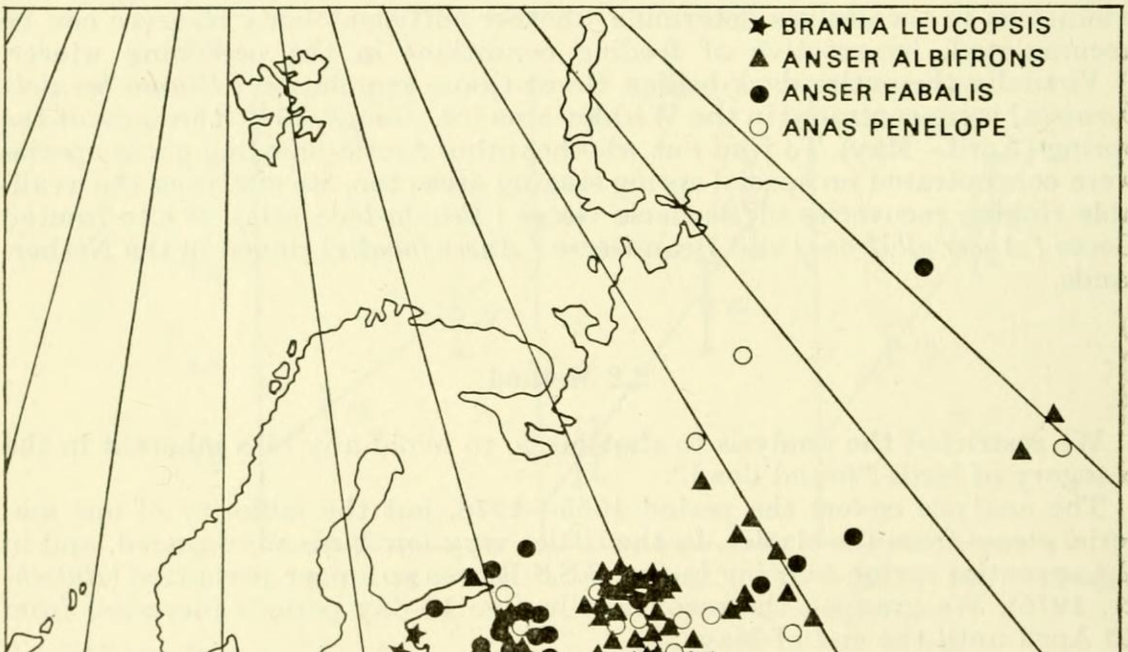

Figure XXVIII/3: Positions of geese and Wigeon(Anas penelope) shot between 20 – 30 April in the period 1955 – 1978, ringed in the Netherlands (see Table 2)

Table XXVIII/2.

Mean positions of spring recoveries of Anser albifrons, Anser fabalis and Anas penelope, ringed in the Netherlands (up to 1978)

Period	*Anser albifrons* n: Mean position	*Anser fabalis* n: Mean position	*Anas penelope* n: Mean position
10 – 20 April	88 54.7 N 39.7 E	11 55.3 N 26.1 E	30 53.6 N 39.1 E
20 – 30 April	112 56.1 N 40.1 E	23 58.1 N 31.0 E	18 56.1 N 49.9 E
1 – 10 May	54 60.2 N 44.0 E	38 64.3 N 40.1 E	51 62.0 N 54.2 E
10 – 30 May	144 67.0 N 47.2 E	107 66.7 N 49.6 E	147 64.5 N 61.8 E

Except for the positions of Anser albifrons and Anas penelope in the period 20 – 30 April all these positions differ significantly from each other (Mardia test, $p < 0.05$)

3. Discussion

From data on family size and the overall proportion of juveniles in the wintering population, it can be inferred that in very good breeding seasons (with a mean of 3 juveniles per family and almost 50% juveniles in the wintering population), two-thirds of the adult birds raise their young successfully. In moderately good years (30 – 35% juveniles) only a third of the adults are doing so. Our results after good breeding seasons with 7 out of 15 returning females being successful do not depart significantly from what one would have expected.

A drawback of the method we applied to investigate the condition hypothesis is that the body reserves Dark-bellied Brent Geese *(Branta bernicla bernicla)* build up each spring are not only used in egg formation and subsequent breeding. The birds have to migrate over 4000 km to reach the breeding grounds. It would be very interesting indeed to have information on body weights upon arrival in Taymyr.

However, because mass migration in a very short period of time is the general pattern in this species, it is unlikely that the migration effort, and thus the amount of weight loss due to it, will vary much between individuals. Thus the impressive spread in body weights at the point of departure from the spring staging areas is not likely to be altered much during spring migration.

In some years all Brent Geese *(Branta b. bernicla)* may have to invest a much greater proportion of their body reserves into migration because of adverse weather conditions (especially continuing strong headwinds). This, of course, might have serious repercussions on breeding success.

Another more serious drawback of our method is that, theoretically, parents arriving in good condition may hatch their eggs successfully, but yet lose their young to predators before these young have become fully fledged. Such parents would, of course, be classified as failed breeders by us. In part, however, the capacity to avoid predation may depend on the individual condition of the parents, as well.

Thus our method does not distinguish in which phase of the breeding season body condition determines reproductive performance.

The frequent occurrence of non-breeding years in Dark-bellied Brent Geese *(Branta b. bernicla)* is usually ascribed to adverse weather during the predation pressure resulting from lemming cycles (*Meltofte*, pers. comm.). The fact that the rate of body weight increment in spring is significantly lower in one of our three years of study, which turned out to be a non-breeding year, indicates that Brent Geese may not always leave these spring staging areas in the same condition each year. This possibly results in non-breeding years even if the weather during the breeding season is favourable.

Another indication of the extreme importance of these spring staging areas is the clear spatial separation between the different species (Fig. 3). We consider this a result of the need to avoid inter-specific competition in this critical period in the annual cycle of Arctic-breeding geese. That different species of geese and Wigeon *(Anas penelope)* are potential competitors food is borne out by observations at other times of the year. Both Wigeon *(Anas penelope)* and Brent Geese *(Branta bernicla)* feed in autumn on eelgrass *(Zostera)*. As a result Zostera beds in several areas are rapidly eaten out *(Charman*, 1979), and then Brent Geese are occasionally observed to chase away feeding Wigeon from the remaining patches of Zostera.

Following the reclamation of the Lauwersmeer area in the Netherlands both Wigeon *(Anas penelope)* and Bernacle Geese *(Branta leucopsis)* eagerly harvested the same rich resource, glasswort (Salicornia), which completely covered about 3300 ha of the vast recently drained mudflats. In this latter case direct interspecific interactions were largely avoided because Wigeon visited the plains during the night, whereas Barnacle Geese came in the daytime (*Prop* & *van Eerden*, 1981). Nevertheless they were feeding on exactly the same resource.

In midwinter, mixed flocks of White-fronted Geese *(Anser albifrons)* and Barnacle Geese *(Branta leucopsis)* are a common sight in the Dutch province of Friesland, while in other parts of the Netherlands mixed flocks of Bean Geese *(Anser fabalis)* and White-fronted Geese *(Anser albifrons)* also occur (*Rooth et al.*, 1981). In these cases too, it is likely that the different species overlap in their food choice.

Therefore separation between these species, either ecologically or spatially, as has been suggested by *Lack* (1974), is not always the case.

When these Arctic-breeding species arrive in the autumn, abundant summer growth in the temperate zone has produced plenty of food to harvest. Because of this abundance, interspecific competition has probably not been severe enough for the different species to evolve exclusive feeding strategies in the autumn and winter. In spring not only are the demands of the birds building up their body reserves much higher, but also food, though high in quality, becomes available day by day only in small amounts.

In such a situation competition for food is more likely to occur, and this, we suggest, resulted in the evolution of segregated spring staging areas for these potentially competitive species.

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XXIX. INFLUENCE OF TEMPERATURE ON ARCTIC-NESTING GEESE

H. Boyd

For the purpose of contributing to a symposium largely devoted to geese in the western Palearctic, it seems appropriate to avoid reporting solely North American events and take a more general view, made possible by the very recent publication of sets of seasonal (*Jones and Wigley*, 1980a – d; *Kelly and Jones*, 1981a – b). The ways in which those indices are derived from station records are described in those publications. The published estimates are expressed as anomalies (i.e., departures from the datum of the mean values from the years 1941 – 1960). I have recalculated them as deviations from the mean for 1950 – 1980, the period in which the goose data are available.

I have brought together the results of monitoring the numbers and breeding success of several goose populations from Eurasia as well as North America, updating the data assembled by *Ogilvie* (1980). A few runs of records extend as far back as 1950. The other records all cover at least ten years. Instead of considering one species or one subpopulation at a time, I have pooled the data by regions and then for the Arctic as a whole. The boundaries of the four regions were determined as much by the availability of records as by geography. The regional collections are: (1) *Alaska* (in which I have also included Ostrov Vrangelya and the northwest of the Northwest Territories); (2) *northeastern Canada*, extending from the Queen Elizabeth Islands to James Bay and from Queen Maud Gulf and the western coast of Hudson Bay east to southern Baffin Island and the west coast of Greenland; (3) the *Greenland Sea* states, i.e., east Greenland, Iceland and Spitzbergen; and (4) *northern U.S.S.R.* from the Kola Peninsula east to the Taymyr Peninsula, including Novaya Zemlya and other offshore islands. I have found no suitable data for northeastern Asia, from 100°E to the Bering Strait, apart from the Lesser Snow Geese breeding on Ostrov Vrangelya.

Three kinds of data are used wherever possible: (1) annual census or index numbers (N); (2) field observations on the proportion of first-winter birds in flocks in autumn or early winter (J); and (3) annual means of observed brood sizes (B). As a supplement in some cases, the proportion of first-winter goose tails found in the samples returned by hunters selected to take part in the U.S. and Canadian species composition surveys are used. Canada Geese have been left out of this analysis as they pose special problems. It is difficult to identify young Canada Geese in the field from September onwards. There are also difficulties in dissecting the information on numbers in winter, usually published state-by-state, so as to correspond whith what is known about the segregation of different populations that overlap in their winter quarters.

This approach to population analysis was pioneered by *Lebret* (1948) in Europe and by Lynch in North America (*Lynch and Singleton,* 1964, and many unpublished reports to the U.S. Fish and Wildlife Service). There are several ways in which the available data may be biased and in only a few cases have large samples been obtained to reflect the composition of very large populations. Seemingly inconsistent results have led several investigators to spend more effort on reconciling regional data, or deploring their use, than in seeing whether the data can be used effectively, despite their obvious limitations.

The notion of pooling results from different species and subpopulations exposed to different local climates will doubtless seem improper to such critics; and the results which follow are sufficiently inconclusive to give grounds for scepticism. Yet it is important to look at large sketches as well as at small, detailed pictures. National agencies must be more concerned with continental than with local fluctuations in the numbers and distribution of geese and their possible causes.

I have combined inventories and observations on family size and the proportion of young geese into two sets of index numbers. The first, a success index (SI), was obtained by assigning annual scores to each constituent and then summing them. Values less than the period mean minus one standard error ($m-s$) were scored as "1"; those exceeding the mean plus one standard error ($m+s$) were scored as "3"; and the remainder, grouped about the mean, were scored "2". For brood size and % first-winter the means of the whole run of years were used. Nearly all the populations concerned increased substantially during the period 1950–1980. In those cases where there were clear trends throughout the period the deviations from the expected population size were used. Where the fluctuations were irregular 5- or 10-year mean population sizes were used to score the year-to-year changes. A complete data set for any population results in an integer score ranging from 3 to 9. Where one of the pieces of information is missing for an entire run (e.g., brood sizes for Atlantic Brent Geese), no entry has been made so that the score could not exceed 6. Occasional missing values have been delat with by inserting a score of 2. For those early years in which few populations were being monitored, no index number was inserted unless at least three statistics derived from 3 populations, in at least 2 regions, were available.

The annual indices from all available data (total success index or TSI) are displayed in Figure 1. There were no significant regional trends extending over the entire period. The TSI show a significant decrease, its correlation with years yielding $R = -0.421$ ($0.02 > p > 0.01$). The mean annual decrement (-0.01) is much less than most of the year-to-year changes. The most important characteristic of the TSI series is that there are no long runs of high or low scores. The wide fluctuations are somewhat surprising given that the method of rating ensures that about 2/3 of the scores for each elements will be "2".

The second indicator shown in Figure 1 is the ratio parents/geese in adult plumage (P/A), Lynch's "field productivity" (*Lynch and Singleton,* 1964). This is obtained from the proportion of the first-winter geese observed (j)

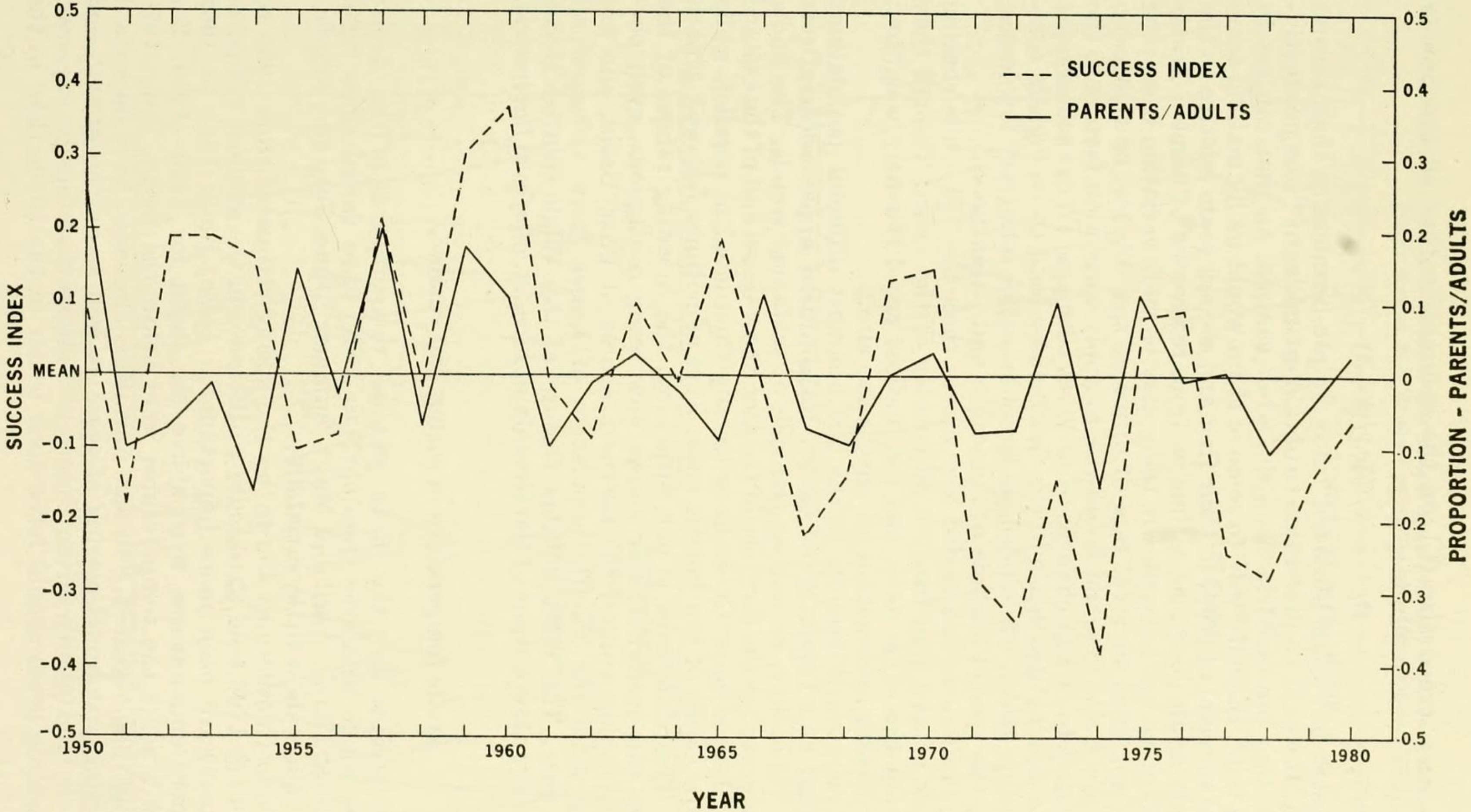

Figure XXIX/1: Variations in annual indices of goose population success and on the parent/adult ratio, derived from field observations in fall and winter. 1950 – 1980 and from the mean brood size ($\bar{b}$), on the assumption that all the broods were accompanied by two adults:

$$P/A = 2/\bar{b} \times J/(1-J)$$

Many of the geese in "adult plumage" may be pre-breeders in their second or third winter. It would be preferable to obtain estimates of "true productivity" by subtracting pre-breeders from the adult sample. As that can rarely be done in the field, the only way to remove them would be by making some estimate of the survival of geese in their first and second years relative to the survival of truly adult geese. As estimates from recoveries of banded Lesser Snow Geese of known age have shown, there may be wide variation from year to year in the apparent survival rate of different age cohorts, so that even from Lesser Snow Geese it would be unwise to apply correction factors to the observed age ratios to reflect changes in survival with age. (What seems most often to be the case is that losses in the first winter tend to be high in comparison with adult losses, while pre-breeders may suffer relatively few losses, as they escape the special hazards of innocence and parenthood.)

The parent/adult ratio has varied less widely than the TSI while sharing with it the lack of any long runs on either side of the mean. Though they are derived from the same data, the two indices are differently weighted. The TSI incorporates information on population size.

Figure 2 illustrates differences in the TSI amongst different populations of White-fronted and Lesser Snow Geese. Its confused appearance reflects the extent of variability, as well as the lack of sustained trends. The Snow Goose plots suggest that the fortunes of Greater Snow Geese and of the eastern populations of Lesser Snow Geese have usually fluctuated in parallel, while the Lesser Snow Geese of the Pacific coast have sometimes followed a path of their own. This difference is not surprising, the breeding ranges of the Greater Snows and eastern Lesser Snows now being contiguous, even perhaps now overlapping around the northern shores of Foxe Basin, and are well separated from the Pacific population of Lesser Snow Geese at all times of the year. The most notable feature of the While-fronted Goose diagram is the very low output of the Greenland race, *A. albifrons flavirostris*.

Arctic temperature in spring and summer

Figure 3 illustrates how the mean seasonal temperatures of the Arctic (defined as the whole land area from 65°N to 85°N) have varied since 1950. "Spring" includes March, April and May; "summer" June, July and August. The summer values show little variability.

The very wide fluctuations shown by the spring estimates from 1950 to 1955, from 1962 to 1968 tend to obscure a difference in the summer temperatures that may have been more important to geese. From 1950 to 1963 all the summer temperatures were above the mean for 1950 – 1980. For 6 of the next 7 years the temperatures were below the mean. From 1970 to 1980 no long runs occurred. Summer warmth is known to have important effects on nesting and brood-rearing of geese as well as on the growth and quality of their food plants. From Figure 3 it might therefore be expected that Arctic-nesting geese should have done better in the 1950s than in the

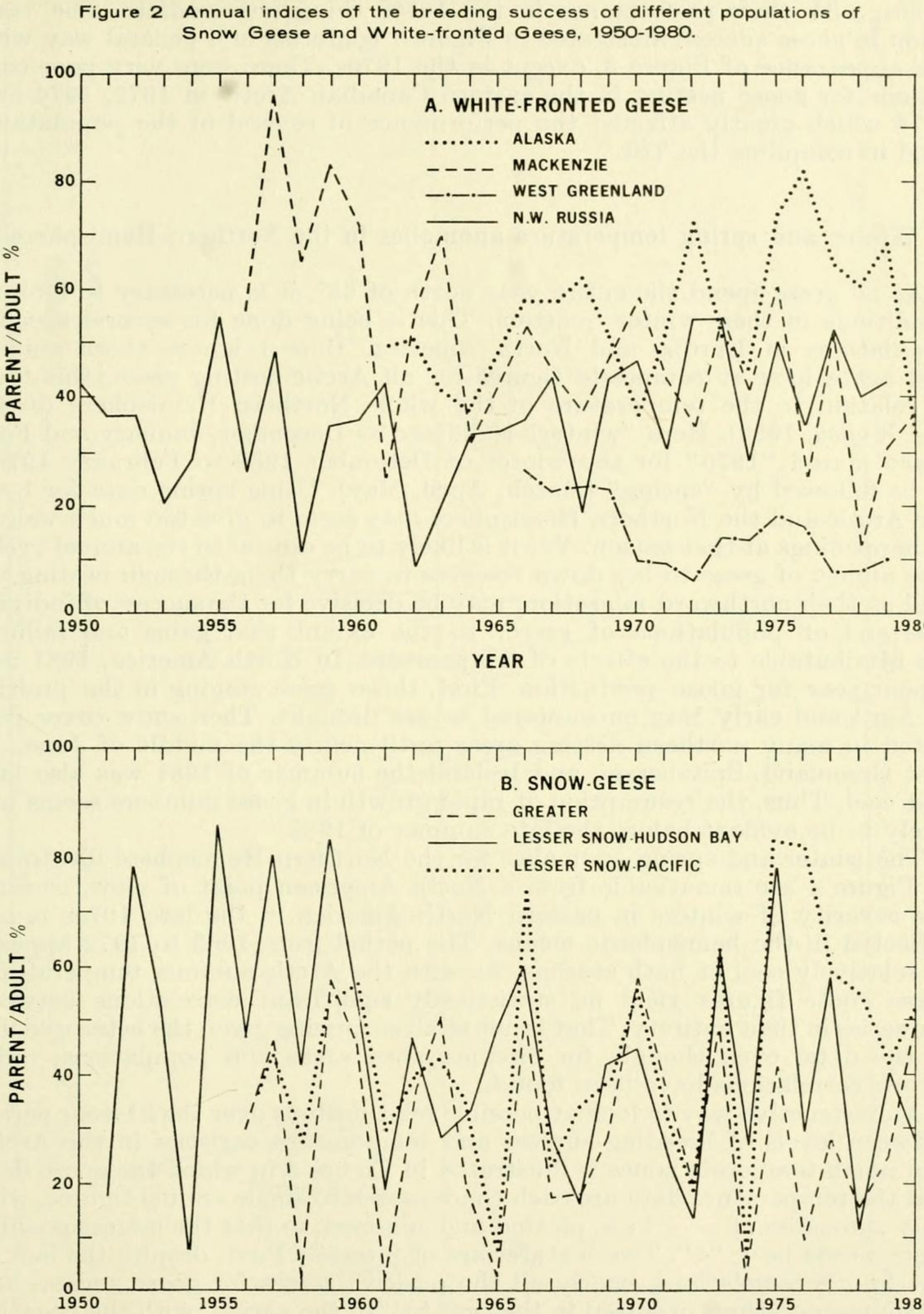

Figure XXIX/2: Annual indices of the breeding success of different populations of Snow Geese and White fronted Geese 1950 – 1980.

1960s, with their preformance in the 1970s being intermediate. The variation in goose success illustrated in Figure 1 conforms in a general way with the appearance of Figure 3, except in the 1970s. There were very poor conditions for goose nesting in the eastern Canadian Arctic in 1972, 1974 and 1978 which greatly affected the performance of several of the populations used in compiling the TSI.

Winter and spring temperature anomalies in the Northern Hemisphere

As no geese spend the entire year north of 65°, it is necessary to look at conditions in their winter quarters. This is being done for several specific populations in Europe and North America. Here I ignore those studies and again look at composite figures for all Arctic-nesting geese, this time in relation to the temperature of the whole Northern Hemisphere (*Jones and Wigley*, 1980). Here "winter" is defined as December, January and February (dated "1970" for the winter of December 1969 to February 1970), to be followed by "spring" (March, April, May). Using spring data for both the Arctic and the Northern Hemisphere may seem to give too much weight to happenings at that season. Yet it is likely to be crucial to the annual cycle. The ability of geese to lay down reserves to carry them through nesting, as well as their northward migration, may be decisive for the success of individuals and of populations of geese, to the extent that gains and failures are attributable to the effects of temperature. In North America, 1981 was a poor year for goose production. First, those geese staging in the prairies in April and early May encountered severe drought. Then snow cover persisted in many northern nesting areas until nearly the middle of June. In east Greenland, Spitzbergen and Iceland the summer of 1981 was also late and cool. Thus, the resumption of rapid growth in goose numbers seems unlikely to be evident before the late summer of 1982.

The winter and spring anomalies for the Northern Hemisphere illustrated in Figure 4 are remarkable from a North American point of view, because the severity of winters in eastern North America in the late 1970s is not reflected in the hemispheric means. The period from 1963 to 1972 appears as relatively cool at both seasons. As with the Arctic summer temperatures these goose figures yield no statistically significant correlations between the series in their entirety. That is not at all surprising given the heterogeneity of the data, even though, for circumscribed areas and populations, quite strong correlations have been found.

An instructive way to look at possible relationships over the 31-year period between levels of breeding success and temperature varieties in the Arctic and north temperate zones is illustrated in Figure 5 in which the goose data and the temperature data are each condensed into single annual figures, with only anomalies of $> \pm 1$ s.e. plotted and summed, so that the largest possible score would be $\pm$ "4". Two features are of interest. First, despite the lack of one-to-one correlations, nearly all the positive scores for goose success and warm temperatures occurred in the first half of the period, with the negative scores similarly concentrated in the second half.

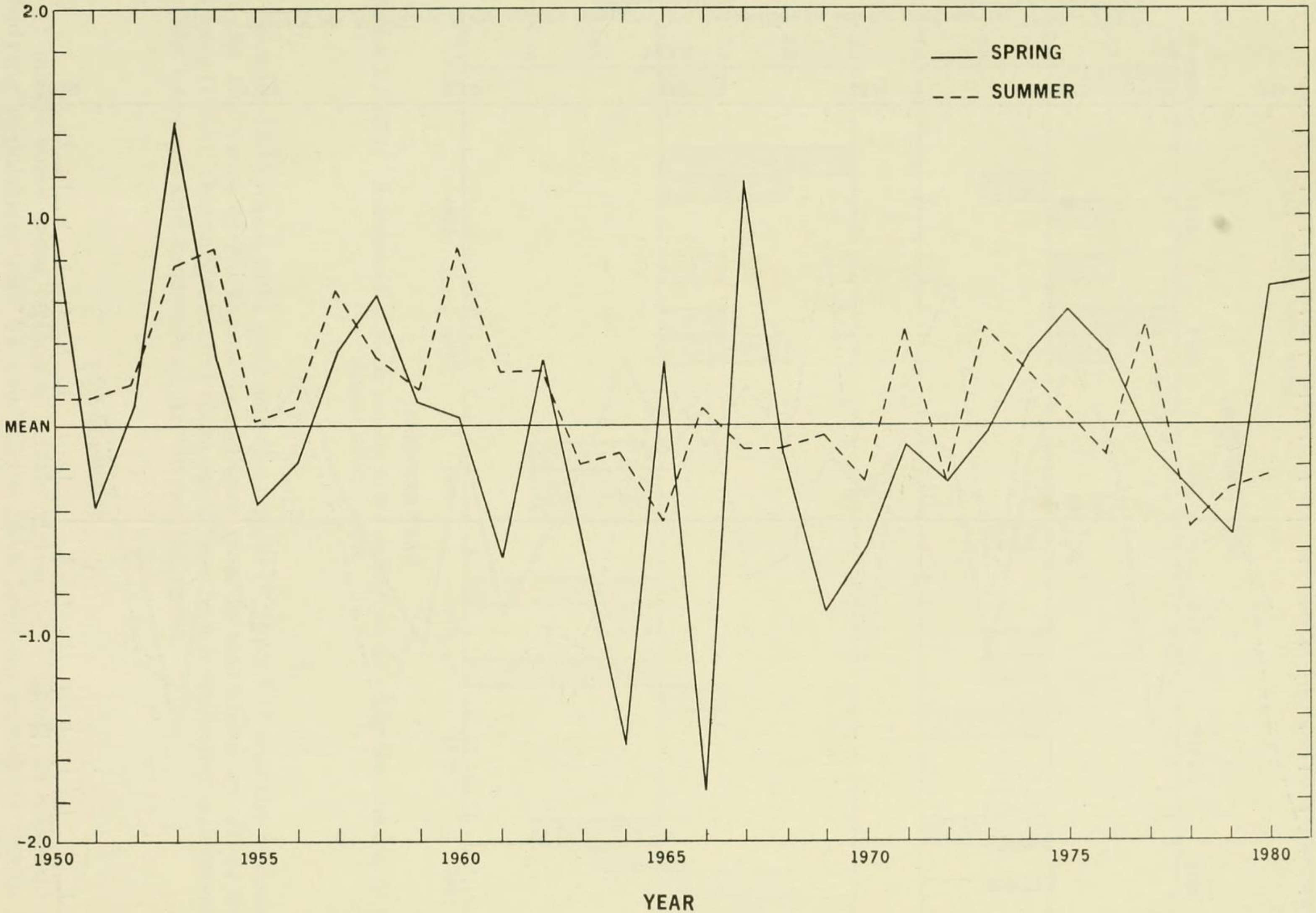

Figure XXIX/3: Arctic temperature anomalies in spring and summer 1950 – 1980.

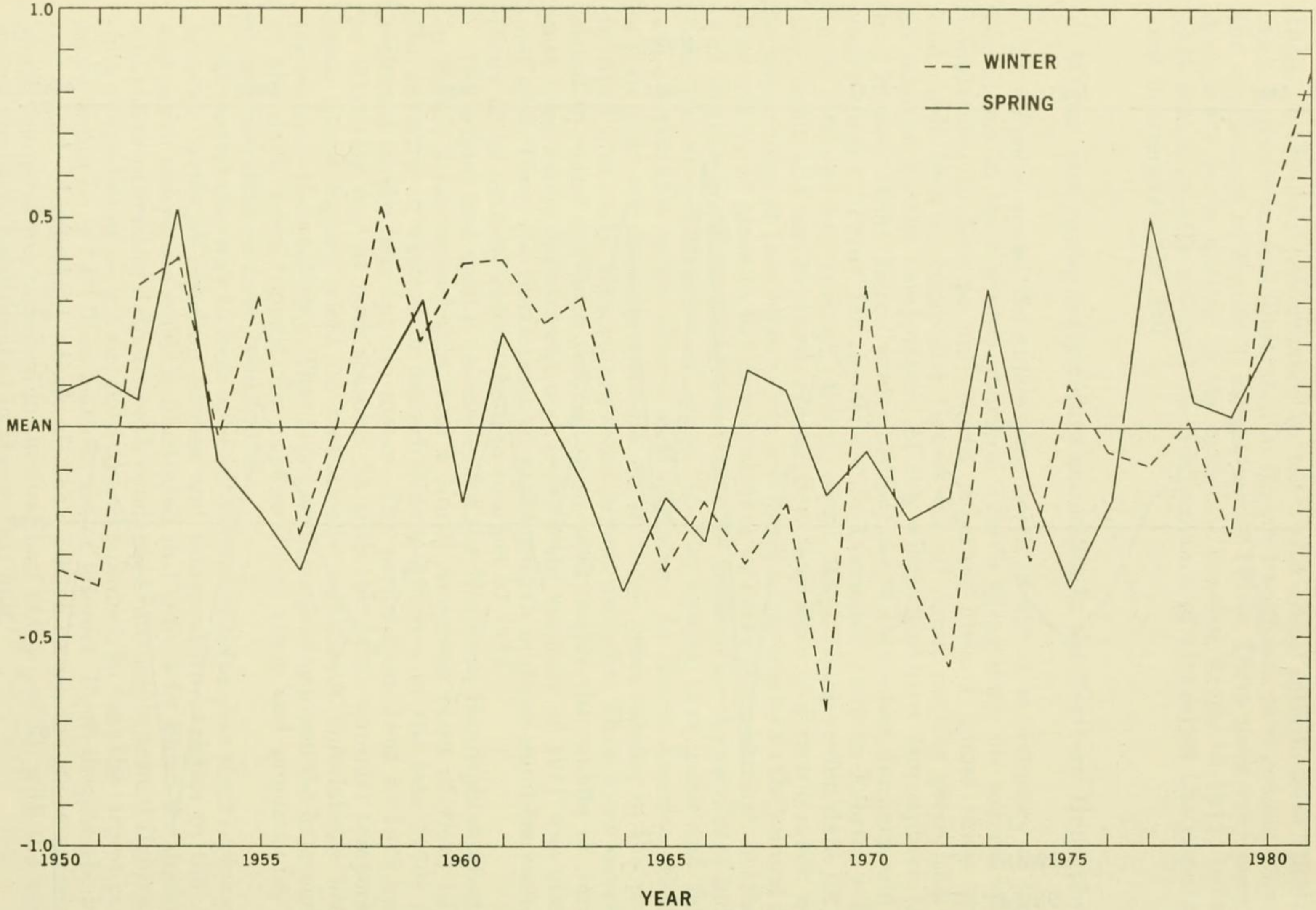

Figure XXIX/4: Northern Hemisphere temperature anomalies in winter and spring 1950 – 1981.

Figure 5 Anomalous values of goose success index and of pre-breeding temperatures in the Arctic, 1950-1980.

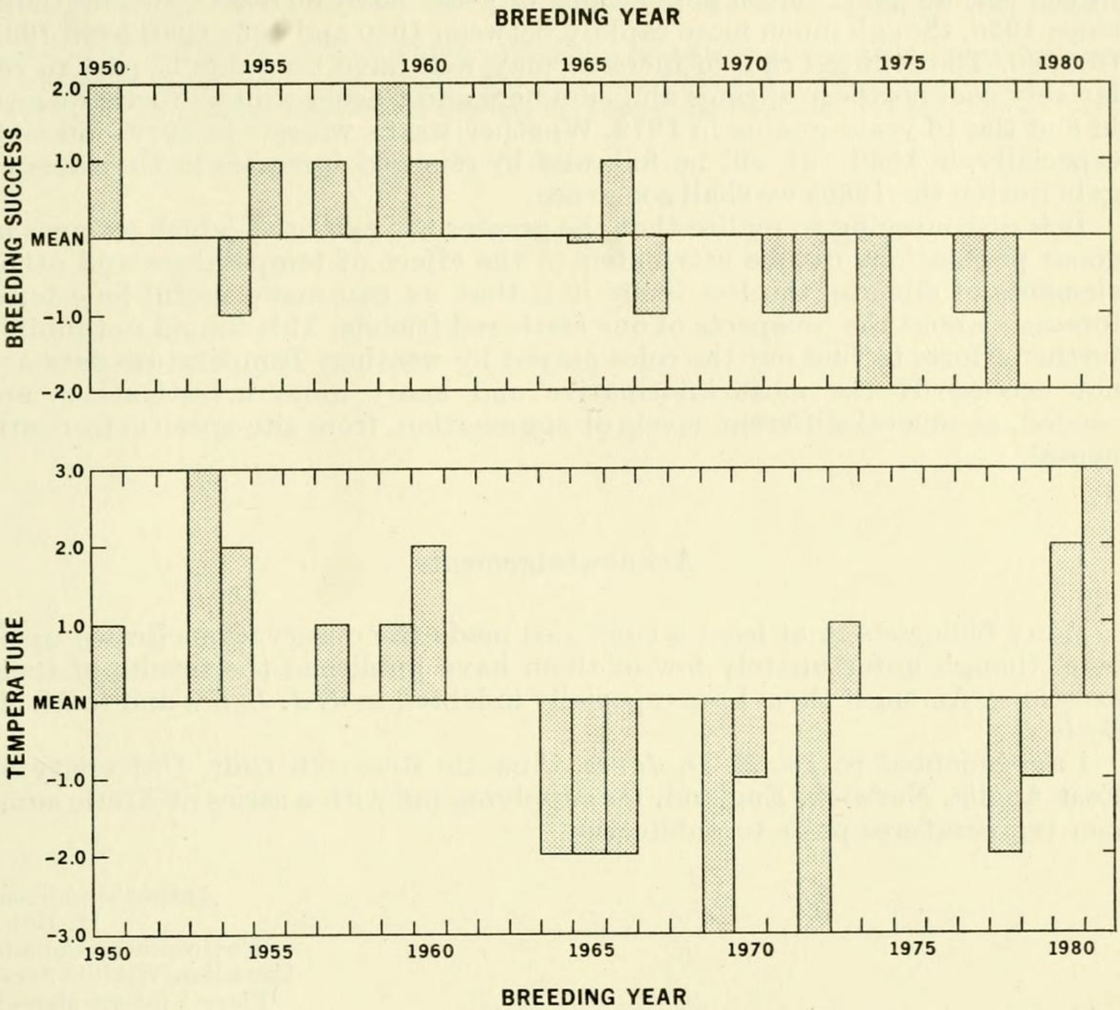

Figure XXIX/5: Anomalous of goose success index and of pre-breeding temperatures in the Arctic, 1950 – 1980.

Second, 1980 was a mild year and the winter of 1980 – 81 was the warmest in the 100 years of Northern Hemisphere records assembled by *Jones and Wigley* (1980). This suggests that there could now be a recrudescence of growth in the numbers and successes of Arctic-nesting geese.

Conclusion

It makes some sense to look at Arctic nesting as a whole, in addition to studying populations one by one. There have been no persistent trends in spring and summer temperatures in the Arctic. Temperatures in summer have varied much less than temperatures in autumn, winter and spring. This may help to explain why there has been poor year-by-year correspondence between northern temperature anomalies and fluctuations in breeding success in the last 30 years. Most populations of geese have increased substantially since 1950, though much more rapidly between 1950 and 1965 than from 1965 to 1980. The reduced rate of increase may well have been due in part to relatively cool northern springs and summers and to cool winters further south in 8 of the 16 years ending in 1979. Whether warm winters in 1979 – 80 and, especially, in 1980 – 81 will be followed by renewed increases in the rates of gain during the 1980s we shall soone see.

It is discouraging to realize that the greater the extent to which changes in goose populations can be attributed to the effect of temperature and other elements of climate, the less likely it is that we can make useful long-term forecasts about the prospects of our feathered friends. This should not inhibit further efforts to find out the roles played by weather. Temperature data are not necessarily the most informative and many more investigations are needed, at several different levels of aggregation, from site-specific to continental.

Acknowledgements

Many biologists in at least 9 countries made the observations drawn upon here, though unfortunately few of them have published the results of their exertions. Amongst them I am especially indebted to *J. J. Lynch* and to *M. A. Ogilvie.*

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XXX. THE MANAGEMENT OF A PROTECTED SPECIES BRANTA B. BERNICLA IN RELATION TO THE POPULATION SIZE, HABITAT LOSS AND FIELD FEEDING HABIT

A. K. M. St. Joseph

Introduction

The increasing number of geese of many species wintering in Europe makes it useful to examine the management of one subspecies which requires no further increase in numbers nor spread in distribution to assure its survival. In this context, management means a more finely tuned reaction to changes in a goose population than imposing complete or near complete protection. Such protection was the major theme of the recommendations set out in *Smart* (1979) for *Branta b. bernicla*. However, the following three examples perhaps suggest that we need to look beyond some of these recommendations to define a more practical set of management principles.

Wadden Sea

In recent years, the reclamation of coastal habitat in the Wadden Sea of the Federal Republic of Germany has been a matter of great concern (*Prokosch and St. Joseph*, 1976; *and Prokosch*, 1977). Approximately 15 000 *B. b. bernicla* are likely to be displaced from the coastal saltmarsh and this will inevitably increase the goose grazing pressure on the offshore islands (Halligen) where the farmers will certainly consider the birds surplus to their requirements and are already applying for permission to shoot the geese in spring (*P. Prokosch*, pers. comm.).

While appreciating the farmers' predicament, it is hardly good conservation to reclaim the semi-natural saltmarsh and then subject the displaced geese to spring hunting because they move into conflict with agriculture. If the island farmers are successful in scaring by shooting, then feeding on arable crops inside the seawall might follow. The damage from that would clearly be the outcome of a failure to integrate the geese into the system of land management in an area whose nature conservation value is both identified and widely recognised.

South and east England

Along the coasts of south and east England up to 40 000 *B. b. bernicla* have fed inland on arable crops and pasture, and yield reductions due to the geese have occurred. Damage prevention is time consuming and exasperating, and farmers do not see why they should bear the cost of what everyone else sees as a desirable increase in numbers. They too would like to shoot *B. bernicla* to stop them feeding on their land, but all that will do is move the flock to a neighbour's field.

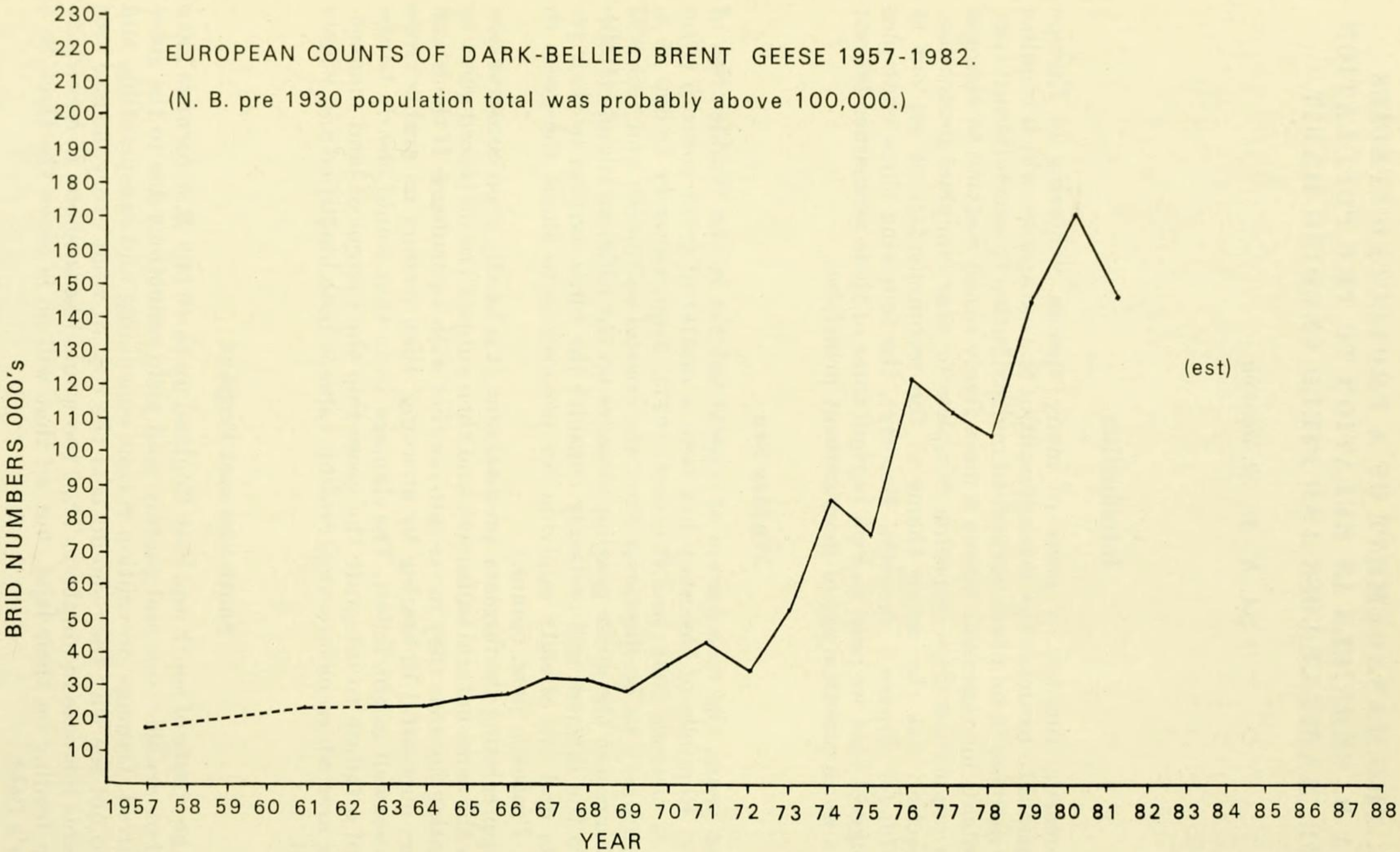

Figure XXX/1: The management of a protected species

Hunting

Considering the increasing number of birds in this population (Fig. 1) and assuming that the decline due to the breeding failures of 1980 and 1981 are not part of a continuing downward trend, could not more hunting be allowed in addition to the present short season in the Federal Republic of Germany? Other goose populations of comparable size are widely hunted. However they are less prone to the dramatic fluctuations in numbers found in all the *B. bernicla* subspecies.

Conclusions

In the Federal Republic of Germany it appears wrong to introduce spring shooting because of pressures brought about by habitat loss. In England shooting for scaring will not, by itself, reduce the incidence of inland feeding on arable crops. There is insufficient control of hunting, bearing in mind that the recovery in numbers is very recent and breeding success so varied, to make it possible to monitor a re-opened season.

Need for international management

The present lack of a management system appears to be due to our inability to agree on and implement a European strategy, not to failure to assess the right course of action. So unless we plan carefully we could see the population continue to increase because no course of action other than near complete protection can be agreed. This is doubly curious to farmers because most birdwatchers appear to them to be more interested in a bird the rarer it is.

How can we use the different national situations of land and conservation management to build an overall plan? Only by having the simplest international agreement on which each nation can build a policy based on its own laws and relating to its particular situation. As far as *B. b. bernicla* is concerned, such a policy need have just four clauses relating to population size, habitat loss, agricultural damage and hunting pressure.

Firstly, there is population size. There appears to be no satisfactory basis for deciding how many geese we "need" to assure the population's survival, let alone how many we would like to see around the coasts of West Europe. What is certain is that the former number would almost certainly be considerably less than the latter and both figures would be extremely artificial.

Since management would be by control of human pressure on the goose population, there is no point in having more than the simplest statement about the acceptable number of geese.

The population level will always fluctuate widely. On one summer (1975) numbers increased by about 45 000 birds (*Ogilvie and St. Joseph,* 1976). The holding capacity of the natural feeding area is also important (*Rogers,* 1977) because until it is reached there seems to be no need to do other than leave the population alone. Surveys in a number of countries (*Schwarz and Rüger,* 1979; *Pfeiffer,* 1979; and *St. Joseph,* 1979) sho that inland feeding on farmland occurs significantly in two out of the five main wintering countries at an overall population level of 100 000 birds.

This population should be recognized as the one to be maintained and it should be accepted that above it management other than complete protection is needed because of the problem created by local inland feeding flocks.

Secondly there is the reclamation of semi-natural habitat. Pressures of land use are very great in West Europe. The opposition to the reclamation plans in the Wadden Sea has helped reduce the size of the planned schemes but they will still be carried out. Farming on the halligs is subsidised at a higher level than on the mainland in Federal Republic of Germany because, although it is less economic, it is considered right and proper to maintain the island communities. Actual agricultural production is therefore of less importance and if wild geese can be included among the natural but manageable hazards of hallig farming (EEC Council Directive 75/268/EEC) there is only need for an administrative agreement within the appropriate department of agriculture. This may not be easy, as the idea may appear too vulnerable to wide exploitation for nature conservation.

Thus instead of outright opposition to the reclamation of semi-natural habitats, a quid pro quo solution should permit the geese to use offshore islands to a greater extent by helping subsidize the farmers.

Thirdly there is the possibility of agricultural damage. Inland feeding has been the main focus for discussion of *B. b. bernicla* management in England. Four separate damage prevention systems have been proposed.

Culling would be technically feasible, with the aim to catch and dispose of up to 12 000 gese in a single winter. However politically unrealistic this might seem, the real drawback is cost. A full-time, all-weather catching team could cost more than £20 000 a year and there are better and cheaper ways of managing a goose problem.

The development of a system of refuges on which the geese should be held (*Owen*, 1979) is possible. Again the main objection is cost which would probably exceed any likely level of crop damage. Big refuges are also known to exacerbate problems in the surroundig farmland by attracting more geese than there were before.

Reliance on shooting and other scaring techniques depends on the farmer's ability to maintain scaring pressure. However, the geese simply smove to another farm. Eventually, the result is that the flocks extend their range, requiring more farms to develop a scaring programme or face economic loss. Such a programme might fragment the flocks and so spread their impact, but experience suggests this is only so when shooting pressure is very high.

The development of alternative feeding sites could be accompanied by licensed shooting over vulnerable crops. The flocks then have somewhere within their home range to be scared to, such as permanent pasture along the coast. Because such fields are widely scattered and small, there is not the same risk of encouraging recruitment as with the larger refuges. Costs too are low, such fields can be incorporated into an existing farm system by application of fertiliser in the autumn and giving up winter stocking. Alternatively they may be paid for by a variety of organisations. Thus the Chichester Harbour Authority arranged payment for mowing grass on a redundant coastal airfield (Thorney Island) to improve the sward. In another case the provision of grazed saltmarsh has been linked with the need to sheep-graze the coastal seawalls to make them more resistant to wave damage.

Because in these ways one can give a proportion of the geese somewhere to go, it is reasonable to put the onus of scaring onto the farmer coupled with shooting under licence. This dual approach of improved scaring and alternative feeding sites are not to be eaten out too soon.

Elsewhere, a return to hunting would involve protracted legal negotiation through the EEC. But in any case it is reasonable to state that *B. b. bernicla* should only be hunted in a country which can adjust season length and bag limit each season and publish adequate kill statistics. The two countries where most *B. b. bernicla* winter (UK and France) have yet to prove that they can do this.

Summary

1. It is reasonable to accept a population level fluctuating around 100 000. This number can be sustained on the natural coastal habitat in the areas where they winter.

2. The protection of natural coastal habitats is of the utmost importance and any geese displaced by development should be included in the agricultural support system if they move onto farm land.

3. Crop losses should be minimised by providing alternative feeding sites, the onus of effective scaring being placed on the farming community with licensed shooting.

4. Hunting can take place at a higher population level (say 150 000) but only in those countries where season length and bag limit can be annually varied to match productivity and where there is no impact on other species. It should not be allowed to reduce the population below 100 000 birds.

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XXXI. WILD GEESE AND MAN IN THE NETHERLANDS: RECENT DEVELOPMENTS

T. Lebret

Introduction

In the Netherlands 14 million people live in an area of about 32 500 km^2 and open spaces are getting rare due to town extension, industrial and harbour developments, refuse dumps and recreational use of land and water. Some 250 000 wild geese which visit our country need these open spaces and therefore they are losing ground. Their haunts need careful management. Various factors, however, are adverse to optimal management. Some of these factors will be mentioned below.

Reallotment schemes

Geese prefer large scale open spaces with little disturbance. Reallotment schemes (redistribution of land) lead to road building and new farms; both causing more disturbance. Moreover, egalization of the land leads to loss of variety in the vegetation and to loss of puddles. In those cases where the area to be reallotted harbours great numbers of geese, nature protection is allowed a certain proportion of the land as a sanctuary. As a rule, this proportion has insufficient carrying capacity for the original number of geese so that some of them have to leave the area and to find other feeding areas. These are as a rule more intensively farmed areas nearby, where the geese are not welcome, so that problems amy arise.

Moreover, the contrast between the small and oppressed goose sanctuary and the over fertilized arable land surrounding it, induces the geese to make regular visits to the latter type of area. This leads to damage claims from the farmers. In the last five years damage up to one and a half million guilders has been paid in compensation.

– The full effect of the reallotting on the geese may be visible only after eight to ten years.

Management of reserves

Of course management depends on the origin of the pasture (old/recent, "natural"/man-made, short-billed/large-billed geese). Recently the general shortage of "natural" areas has led to a call for "multiple purpose reserves" among conservationists:

– There is an alarming decrease in breeding areas for some waders especially *Philomachus pugnax, Gallinago gallinago* and also *Tringa totanus,* caused by deeper drainage and (over) fertilization of pasture. As these waders prefer low-lying, rather poor and wet meadows, and a number of goose reserves suit breeding waders, it seems obvious to keep these areas poor and wet. But this of course decreases the carying capacity for wild geese.

– A similar effect is caused by the tendency to protect rare plant communities restricted to wet and poor meadows. The bigger the area, the greater the variety of rare plant species. Hence a division between smaller areas for rare vegetation types and greater ones for the geese cannot solve this problem.

– Recently closed estuaries give special problems. Reserves on low-lying sand bars in these areas present the same dilemma: excellent breeding conditions for breeding waders including *Recurvirostra avosetta* and terns, and good habitats for rare plant communities. The former tidal pastures were "fertilized" by the tide. In such cases fertilization with some 100 kg/N/ha would be acceptable (*Fabritius*, 1979).

Damage

Most farmers agree that winter grazing of wheat and barley by wild geese does not cause damage. This has been proved to be true by *van Dobben* (1953), *Markgren* (1963) and *Kear* (1970) among others. Early grazing by the first *Anser brachyrhynchus* to arrive and spring grazing by *Anser anser* and *Branta bernicla*, however, is a source of damage.

A. brachyrhynchus arrives in the province of Friesland in October and most of the pastures are still grazed by cattle or harvested for silage by that time. Wildfowlers are not eager to shoot at the freshly arrived *A. brachyrhynchus* and prefer to keep them in their area rather than disturbing them which might cause their departure and spoil future shooting. The species is protected in the Netherlands though shooters say they cannot distinguish them in the field under shooting conditions.

A. anser breed in the Netherlands (both wild and feral birds) totalling some 200 to 250 pairs. There is also a wing moulting population of some 7000 birds in one reserve. The presence of *A. anser* during summer may lead to some complaints. In the province of Zeeland 8677 guilders were paid out in compensation in 1978, 480 in 1979 and 2580 in 1980. *A. anser* will be reduced here to three pairs at one site.

B. bernicla departs at the end of May. Moreover, they have developed a taste for grazing on inland grain fields. On the Isle of Texel the government has bought a farm of 110 ha where the geese are concentrated by scaring them from other fields. One man is employed as a full time scarer and moreover there is one special licence for a wildfowler to disturb *B. bernicla* by shooting.

An experiment on the Texel model will be carried out on a property of 1500 ha in the province of Zeeland.

Resowing of meadows

A recent habit, especially in the province of Friesland, is the frequent resowing of meadows. Each year some 7% is resown in an area of some 100 000 ha (Friese Maatschappij van Landbouw in litt 30 March 1981). The cost is about 1150 guilders per ha. The reason for resowing is that an earlier crop can be harvested and that cattle density may rise from 1 to 3 head per ha. Geese are said to have some preference for freshly resown meadows which is conceivable, as pioneer vegetation was their original food.

An average of 245 guilders per ha has been paid in compensation in this type of meadow in Friesland (report of Friesland Game Damage Committee) in 1977.

Unequal ripening of grain

An alleged source of damage to grain by geese is unequal ripening of grain (Ned. Jager 26 March 80). It is claimed that unequal ripening is due to grazing by geese. However, unequal ripening may occur on practically any grain field, independently of the presence of geese according to three farmers in the province of Zeeland and the Agricultural University at Wageningen. Among the farmers is the director of the above-mentioned property of 1500 ha, which is visited by thousands of *Anser fabalis* every winter without damage of any kind being caused.

Unequal ripening may be due to:

– lower soil temperature caused by unequal humidity;

– unequal sowing and fertilization at the point where the tractor turns, by overlap, unequal soil level or wind effect;

– unequal soil density in the tracks or turning points.

The author is not taking position pro or anti-shooting here, but he strongly opposes this kind of finding as a "justification" of shooting.

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XXXII. GOOSE SHOOTING AND PREVENTION OF DAMAGE

G. den Uil – T. Lebret – J. Philippona

Daily observations of goose shooting were made in an area of about 6000 ha of pastureland in the province of Zuid-Holland in the Netherlands. Goose shooting is allowed from 1 September to 31 January, but only from 30 minutes before sunrise to 1000 hrs. There were 14 hides in the area with 4 to 40 live decoys. During 40 shooting days between 15 December 1980 and 31 January 1981 observations were made near one third of the hides in rotation, from 830 – 1000 hrs. Occupation was 60% with an average of 3.3 shooters per occupied hide. 369 shooters were counted. During 30 hours of observation, 80 geese were observed to be shot, which is 80 : 30 = 2.67 geese per hour. The length of the season is 40 days, which, at 1.5 hours per day, gives 60 hours. Hence per season per occupied hide $60 \times 2.67 = 160.2$ geese were shot on the average. As 60% of the 14 hides (8.4 hides) were occupied on average, the total annual bag of all occupied hides may have been 8.4×160.2 = some 1344 geese. 274 more geese appeared wounded but continued flying. The average number of geese in the study area was 4200 of which 90% were *Anser albifrons* and 10% *A. fabalis*.

The geese in this area came from 3 roosts. In two other areas visited by geese from the same roosts 11 and 19 hides were seen.

Shooting as practised in this area of 6000 ha causes a lot of disturbance and a considerable proportion of the geese which might feed in the area are forced to feed elsewhere, with a high chance of using arable land. In the study area (pastures) the farmers are unanimous that the geese do not cause damage. On arable land there may be complaints and compensation payments. The conclusion is therefore that goose shooting, as practised in the study area, is leading to damage elsewhere rather than preventing damage and hence could better be stopped or at least greatly reduced.

The study focusses attention on the fact that goose shooting is generally practised with no positive relation to damage prevention and even adversely affects prevention by disturbing the geese where they cause no damage. A "Note on Goose Shooting" by the KNJV (Royal Netherlands Hunting Association) pleads for goose shooting to continue according to the general practice (morning flight shooting up to 1000 hours), be it with much self restraint and not on feeding grounds unless necessary for the prevention of damage. However, the latter advice is hardly respected anywhere.

Lebret & *Philippona* (in prep.) feel that if goose shooting is of any positive value for damage prevention, the general practice should be changed fundamentally as follows:

Rule 1. No shooting at geese at localities where they feed without causing damage.

Rule 2. Development of disturbing shooting tactics for places where damage by geese occurs.

Rule 2 has several implications:

– there should be an authority judging where damage occurs;

– there should be an organisation which could act with the requisite speed;

– disturbing shooting practices should be developed (see Appendix).

Generally speaking goose shooting cannot be a leisure sport where the initiative is on the side of the wildfowler. It should be an activity integrated in agriculture.

Of course, there should be a guarantee that fake "damage" is not used to evade Rule 1. Such and other possibilities of abuse are built into the proposed changes. On the other hand, present practices are far from satisfactory. The amounts of public money involved in indemnification of farmers are soaring (vide Table 1.). Their increase is not proportional with the increase in the number of geese but with changes in policy and with an increasing tendency for farmers to claim indemnification. A different approach to the damage problem is therefore urgently required.

A minor complication is that those wildfowlers who used to shoot in non damage areas might feel dispossessed by Rule 1. A transitional period of some 5 years in which the open season is shortened by 10 days per annum might mitigate this "loss" and give them time to integrate into damage prevention practices.

The possibilities of abuse might be reasonably small if state nature protection officials took part in the activities of the network judging whether certain fields were suffering damage. Another important factor might be the maintenance of goose feeding areas (especially by fertilizing), to distract the geese from crops susceptible to damage.

Table XXXII/1.

Sums (in guilders) paid for goose damage compensation in the Netherlands (data from the "Jachtfonds")

1955	–	1964	–	1972	5 063.–
1956	12 154.–	1965	–	1973	4 200.–
1957	676.–	1966	–	1974	6 220.–
1958	45.–	1967	277.–	1975	108 233.–
1959	–	1968	–	1976	350 200,–
1960	–	1969	–	1977	411 700,–
1961	–	1970	8 080.–	1978	218 637.–
1962	2 225.–	1971	7 125.–	1979	548 178.–
1963	–				

Appendix

Damage prevention teams may work as follows (adapted from Owen & Thomas 1975): Today's practice is to shoot at small units of geese as they come in on morning flight, so as to cause minimal disturbance, to have a maximum bag and an optimum chance of returning a second time. The proposed practice is to surround the field by shooters in hides. When the geese are coming in, shooting should not start until after the end of the flight, so that a maximum number of geese learns that the field is unsafe. A follow-up might consist of placing hides in the centre of the field, incidental shooting and of using bangers. Unemployed nature protection minded juveniles may be willing to do extra scaring work.

The proposed shooting system will lead to smaller bags and a relatively high use of cartridges. The costs of the latter might be subsidized by the farmers' organisations and/or public money. Anyway the proposed system should save a considerable amount of public funds and is therefore preferable.

Compensation was paid for the first time after the severe winter of 1956, but no compensation was paid after that of 1963. There appear to be two major changes in payment policy: 1970 was the beginning of a series of five years of payments between 4000 and 8000 guilders. Another change came in 1975 when the threshold of 100 000 guilders was passed. The severe winter of 1978/79 is remarkable with over 500 000 guilders. No correction for inflation has been applied in these figures.

The only goose species which may have affected the amount paid in compensation by an increase in numbers is *Branta bernicla*. Hovewer, the special *B. bernicla* farm on the Isle of Texel will pay off in the years to come.

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XXXIII. THE "NIEDERRHEIN" (LOWER RHINE) AREA (NORTH RHINE WESTPHALIA, FEDERAL REPUBLIC OF GERMANY), A GOOSE WINTERING AREA OF INCREASING IMPORTANCE IN THE DUTCH-GERMAN BORDER REGION

J. H. Mooij

Introduction

For many years the German "Niederrhein" (Lower Rhine) has been visited every winter for a shorter or longer period by wild geese (*Hartert*, 1887, *Le Roi*, 1906 and *Le Roi* & *Geyr von Schweppenburg*, 1912). Although reliable numbers are not known, it is certain there were only a few compared with today's numbers.

Description of the area

The wintering area for geese is situated on both sides of the River Rhine, between the Dutch town of Nijmegen and the capital of the Federal Republic of Germany, Bonn. The main part, where more than 99% of the geese winter, lies between Nijmegen and the German industrial city of Duisburg, along some 90 km of the Rhine, mainly of German territory in the federal state of North Rhine Westphalia (Fig. 1).

The goose feeding places are in the immediate neighbourhood of the Rhine, partly on the regularly flooded, grassy banks of the river (±15%), partly beyond the highwater dikes. They feed mainly (±86%) on grass fields (Fig. 2), and sleep on the banks of the Rhine and its old branches (Fig. 1).

In this traditionally agricultural region great changes have been going on in the last few years. An increasing part of the pastures in this formerly wet, grassy area have been converted into fields for winter grain, sugar-beet and maize, or into industrial areas, deeplakes and recreation areas. At the same time the number of wintering geese has constantly been growing.

Goose species

In the lower Rhine area the majority of the geese (±78%) are *Anser fabalis* (mainly of the subspecies *A. f. rossicus)*, followed in number by *Anser albifrons albifrons*. Every winter small numbers of *Anser anser*, *Branta leucopsis* and *Branta canadensis* are found in the feeding flocks.

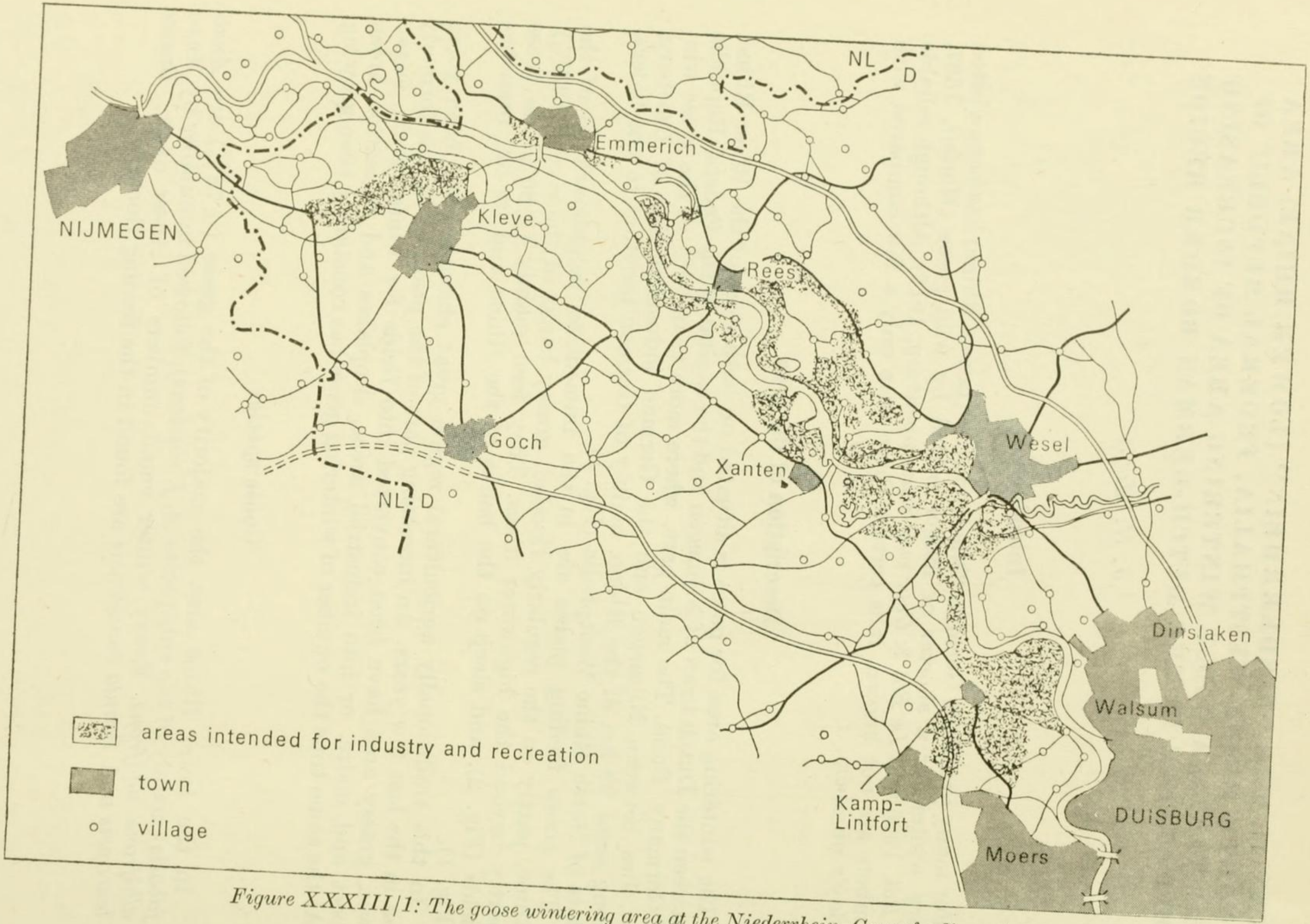

Figure XXXIII/1: The goose wintering area at the Niederrhein. Goose feeding places

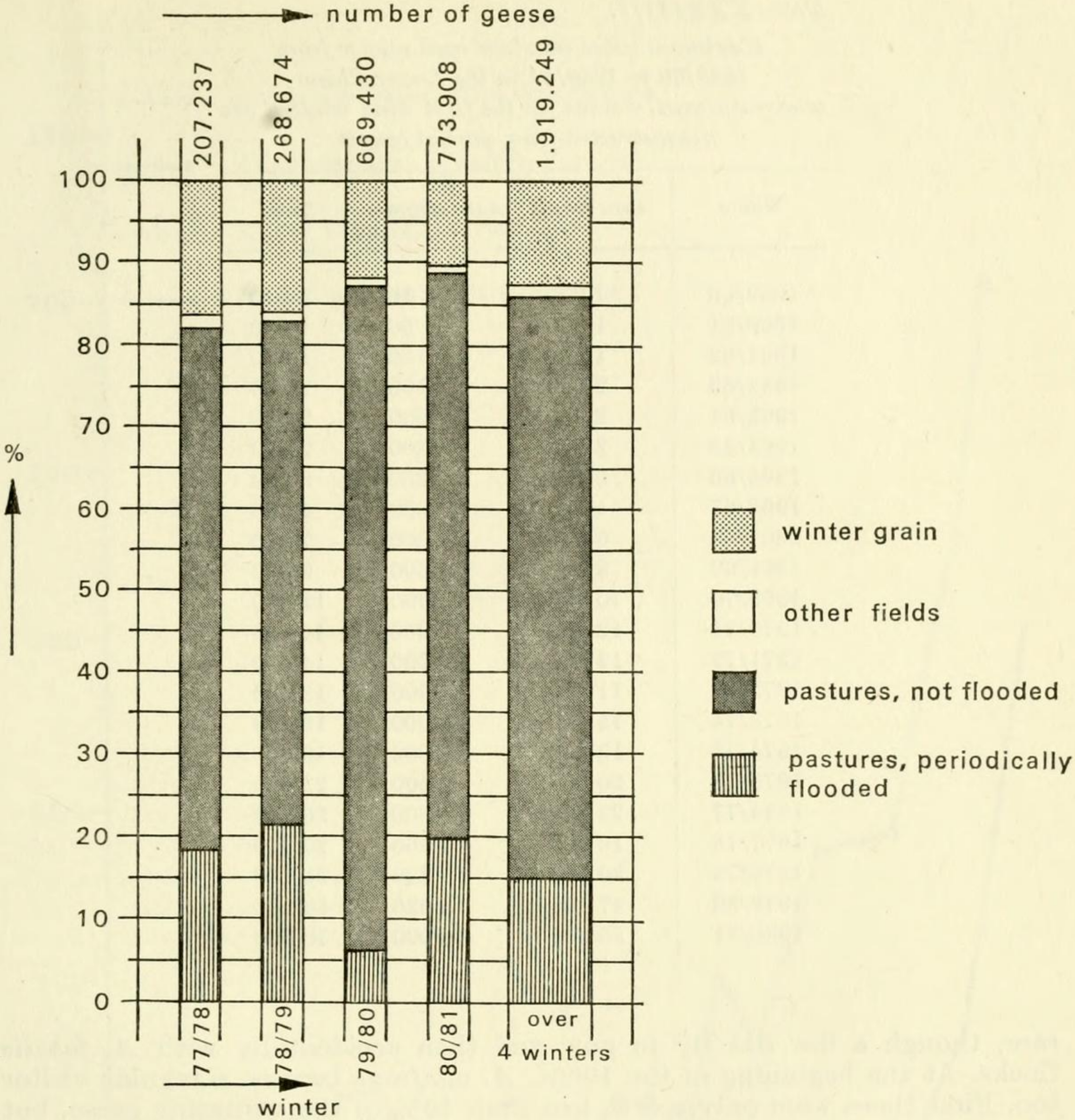

Figure XXXIII/2: The choice of fields by the geese at the Niederrhein, calculated as a percentage of the total number of geese observed in four winters (170 Observation days)

Goose numbers

Until the beginning of the sixties there were no data about the number of geese wintering in the Lower Rhine. Only from the publications mentioned above and the memories of farmers and hunters, is it known that geese did winter here a long time before the first incomplete counts were made.

As far as can be reconstructed (*Mooij*, 1979b), till the end of the 1950s only *A. fabalis* visited the Lower Rhine periodically in any numbers (1000 – 1500 at that time), and for any length of time (Table 1) *A. albifrons* was

Table XXXIII/1.

Maximum goose numbers each winter from 1959/60 to 1980/81 in the Lower Rhine wintering area. Counts for the first nine winters are reconstructed from partial counts

Winter	*Anser fabalis*	*Anser albifrons*	Total
1959/60	1 000	10	1 010
1960/61	1 500	50	1 550
1961/62	1 500	150	1 650
1962/63	2 000	100	2 100
1963/64	2 340	200	2 540
1964/65	2 770	200	2 970
1965/66	3 400	250	3 650
1966/67	4 100	600	4 700
1967/68	6 610	1 000	7 610
1968/69	8 090	1 500	9 590
1969/70	10 720	1 600	12 320
1970/71	12 450	2 350	14 800
1971/72	12 480	2 200	14 680
1972/73	11 490	1 900	13 390
1973/74	15 200	3 000	18 200
1974/75	13 600	3 000	16 600
1975/76	20 500	2 500	23 000
1976/77	23 500	2 800	26 300
1977/78	16 900	3 160	20 060
1978/79	20 590	5 520	26 110
1979/80	47 160	9 020	56 180
1980/81	55 000	15 000	70 000

rare, though a few did fly in now and then accidentally with *A. fabalis* flocks. At the beginning of the 1960s. *A. albifrons* became a regular visitor too. First there were only a few, less than 10% of the wintering geese, but the proportion slowly increased.

About twenty years later, in the winter of 1980/81, some 70 000 wintering geese were counted on the Lower Rhine. 15 000 (more than 20%) were *A. albifrons*, the remaining 55 000 *A. fabalis.*

With an increase of more than 4000% between the winters of 1959/1960 and 1979/1980 the increase of the *A. fabalis* population on the Lower Rhine is in harmony with that of the west European population. Over the same period the west European population of *A. albifrons* grew by 450%, while the Lower Rhine population grew by more than 90 000% (Fig. 3).

In the last few winters more than 20% of *A. fabalis* wintering in western Europe and about 2% of the west European population of *A. albifrons* have wintered on the Lower Rhine. All these figures show that, although little known, the Lower Rhine area is among the most important wintering

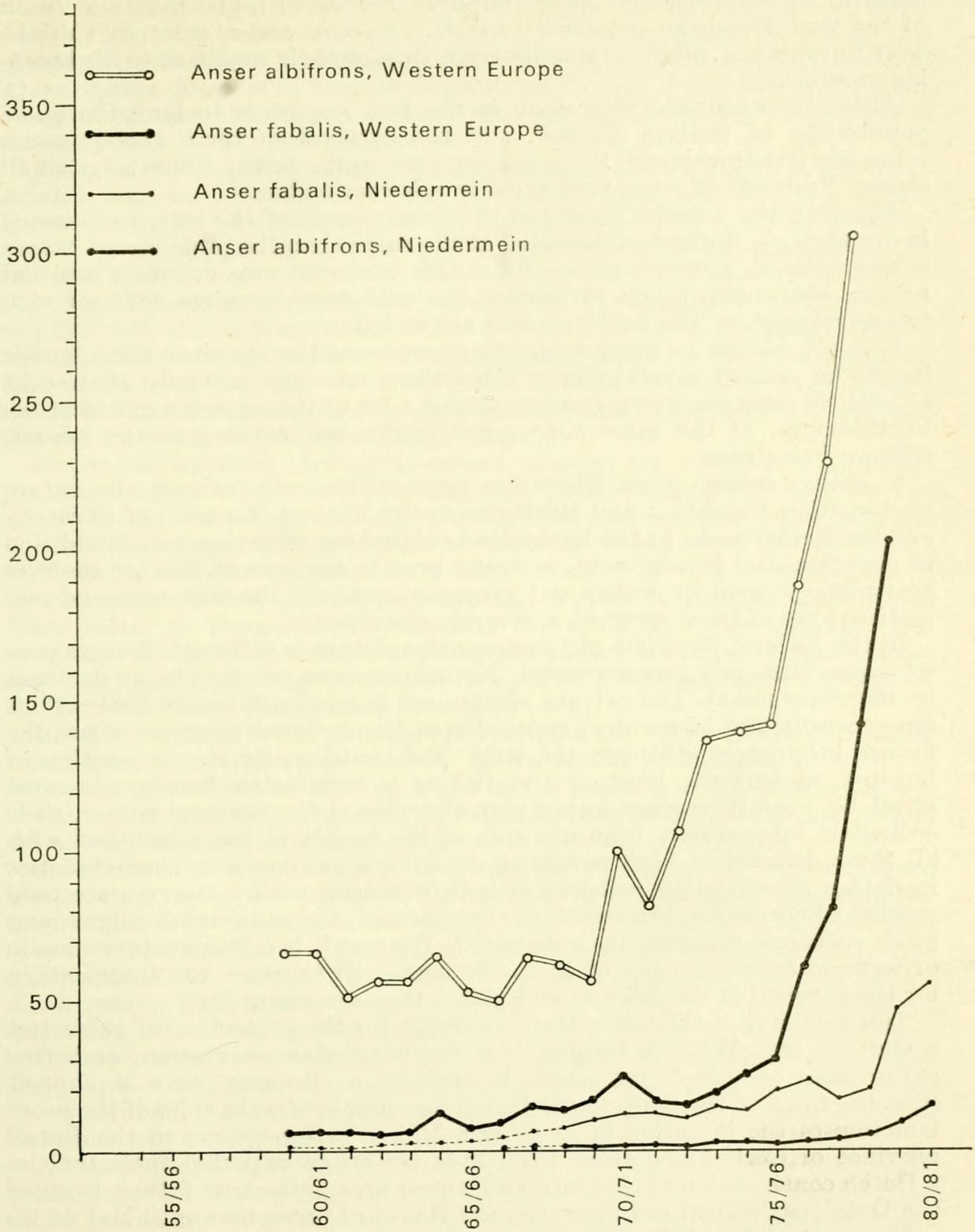

Figure XXXIII/3: Wintermaxima of Bean Geese (A. fabalis) and Whitefronted Geese (A. albifrons) in Western Europe (after Ganzenwerkgroop 1976, 1977, 1978, 1979, 1980, Philippona 1972 and Timmerman 1976) and at the Niederrhein (after Mooij 1979/b) in the period from 1959 till 1981.

areas in western Europe. Moreover there are strong signs that almost all of the west European population of *A. f. rossicus* and a great part of the west European *A. albifrons* stay for some time on their way back to the breeding grounds.

Although much has been done in the last few years to save the goose populations of western Europe, and the survival of these goose species is not directly threatened, the wintering area on the Lower Rhine is not at all secure. Problems of goose protection in a border region.

Although the increase described delighted people of the region interested in ornithology, it clearly illustrated at the same time the problems of nature conservation in a border region. Since this wintering area crosses a national border, every step taken to protect the wild geese requires dealings with two governments. The problems met are as follows:

1. Goose counts. In every complete goose count the Dutch-German border has to be crossed several times. Since these crossings are only allowed at official checkpoints, every counter wastes a lot of time driving and waiting. Furthermore, at the same time goose flocks can move over the border, without being seen.

2. Nature conservation. There are great differences between the nature conservation legislation and strategies in the Federal Republic of Germany and the Netherlands. In the Netherlands nature conservation has, in addition to governmental involvement, a strong private component. Nature reserves are mostly bought or rented and generally speaking the economic and recreational use of these reserves is severely restricted.

In the Federal Republic of Germany the picture is different. Nature conservation is mainly governmental. Nature reserves are bought or declared by the government. The private component is relatively small. Restrictions are generally few in number, especially in the declared reserves, where the former proprietors still own the land. The traditionally strong position of forestry, agriculture, hunting and fishing is very often hardly weakened at all. So, even if reserves do not stop abruptly at the national border, their ecological value differs from one side of the border to the other. But with all these differences both countries do have some common characteristics in nature conservation policies: in both countries nature reserves are only created where economic interests are not harmed, and can survive only as long as no economic interests are announced. The result is a fragmentary mosaic of wetland reserves, each of them too small, all together too fragmentary for the survival of the animals and plants they are meant for.

This means that there is a Dutch concept for the protection of geese and a German one. What is lacking is a Dutch-German conception, or better a European one. In North Rhine Westphalia a "Ramsar" area is planned from the town of Duisburg to the Dutch-German border. In spite of the proclamation of the intention of creating a Rhine Valley reserve in the Dutch province of Gerlderland from 1977, it is not to be expected there will be a Dutch continuation of the German Ramsar area in the near future, because the Dutch parliament did not ratify the Ramsar Convention until May 1980.

The Federal Republic of Germany ratified the Ramsar Convention in 1976. However, although the international importance of the area was underlined in several publications (*Haarmann*, 1977, *Mooij*, 1979b) and even in an official research paper of the federal government (*Nake-Mann* & *Nake*, 1979), the state government of North Rhine Westphalia gives economic interests absolute priority over nature conservation. The wetland reserves within this planned North Rhine Westphalian Ramsar area, one of the most important goose winter quarters in western Europe, are too small. Important areas are left out because of strong economic interests and the use of the protected areas by man hardly restricted at all.

3. Goose hunting. The hunting situation is rather complicated. In the Netherlands and in most states of the Federal Republic of Germany several goose species may be hunted, whereas in the state of North Rhine Westphalia, all goose species have been totally protected since the hunting season of 1974/75. It is a pity, however, that nothing is done to prevent the shooting of small game on the fields where geese feed. The result of the ban on hunting in North Rhine Westphalia is that geese wintering in the border region, though still roosting in the Netherlands, feed more on German territory. This leeds to actions like those of Dutch hunters, who scare geese feeding in the German border region over the frontier, where their hunting colleagues, warned by walkie-talkie, try to shoot them.

Beside the constant increase in recent years in the number of wintering geese in the Lower Rhine, it is the different hunting regulation on either side of the border, that displeases German farmers and hunters living near the border. They argue that it is not fair that the Dutch have the "pleasure" of shooting and the Germans have the "trouble" of tens of thousands of feeding geese. So they asked for a reopening of goose hunting in North Rhine Westphalia, or financial compensation for so-called goose damage. But in spite of the growing number of geese, the author has failed to find a single real case of goose damage in the last five years of research, and furthermore, the farmers shared this opinion (*Mooij*, in prep).

In addition there is the problem of explaining the logic of forbidding goose hunting and creating goose reserves North Rhine Westphalia, to save the wintering geese from extinction, while at the same time, on the Dutch side of the border, a short distance away, Dutch hunters (and their German guests) are allowed to shoot as many as they want (see *Mooij*, 1979b).

4. Information gap. Despite international contacts, an intereuropean border still really can separate the people on either side. Transfrontier cooperation only exists in a few cases. When the effect of a regional plan does not cross the frontier, such plans in most cases are hardly known on the other side of the border. The same involuntary ignorance exists in nature conservation. Each side is planning, protecting, saving and making research on its own side of the frontier. Official bilateral contacts are too few in number, mostly refer to transregional problems and the few results seldom affect the people working in the region. Regional border-crossing contacts could be very fruitful, but are almost always of a private character and are therefore unfortunately ineffectual.

All these problems render goose protection and goose research more difficult in a border region. And all these problems will grow every year, because of the increasing concentration of the Lower Rhine geese in the immediate neighbourhood of the frontier, in the "Bijland-Komplex" (Fig. 4); "Komplex" is used to mean the unit made up by a roost and the feeding places visited by the geese in that roost. (See *Mooij*, 1979b.)

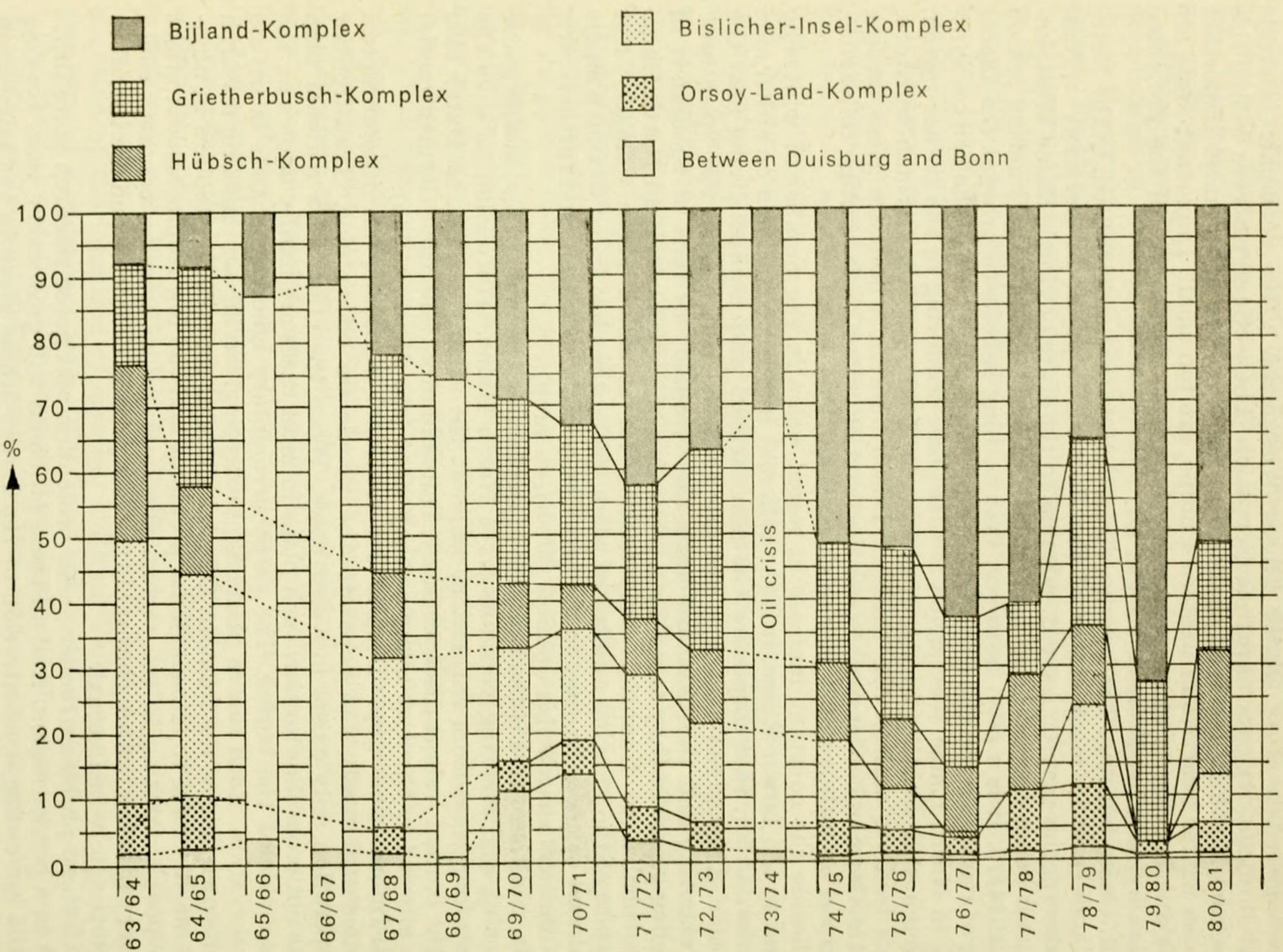

Figure XXXIII/4: Distribution of geese over the "Niederrhein" area at the time of wintermaximum, calculated in a percentage of the total number at that time, in the period from 1959 till 1981.

How politicians think about the Lower Rhine is becoming very clear, when they talk about the "Lower Rhine coastal industry location" as the perfect expansion area for heavy industry. When all the plans for the area have been realized in a few years, the following situation will exist (see Fig. 5 and 6).

1. There will be no more worries about nature in the 22 kilometres of the Rhine from Duisburg to Wessel. On both sides of the Rhine there will be expansion of the Ruhr-Gebiet, with in between, surrounded by industry and power plants, a wetland of 450 ha, called Walsumer Rheinaue. More than 1200 hectares of beautiful wetland, wintering place for up to 5000 geese (among other species), called Orsoy-Land/Orsoyer Rhein-bogen, will be sacrificed to industry (see *Mooij*, 1979b for "Orsoy Land Komplex").

2. In the next 25 km of the Rhine, from Wesel to Rees there will be great changes. The Lower Rhine is the most important gravel supplier in North Rhine Westphalia and gravel is found under the banks of the Rhine. So the gravel industry is digging up the river banks between Wesel and Rees, leaving behind some flat pastures without relief and a lot of water, divided into many big deep lakes. Most of these sheets of water are used for recreation.

At the moment there is one nature reserve of 117 ha in this area. It is planned that up to 1000 ha of partly refilled gravel pits will be added, so that in maybe twenty years a nature reserve of some 1200 ha will exist. Therefore nature has to do without some 1500 ha, that have been changed into lakes up to 15 m deep, with intensive and noisy recreation. Of more than 3000 ha of wetland, potential and actual feeding places for up to 20 000 geese (among other species), only half will remain. And this half will be ecologically devalued by lack of relief and hedges, both characteristic of the goose roosts and feeding places in the Lower Rhine wintering area. The Bislicher-Insel-Komplex and the Hübsch-Komplex will lose a lot of their attraction for geese.

3. In the following 15 km, from Rees to Emmerich (the "Grietherbusch-Komplex"), coming changes will not be so great. Of about 1900 ha of goose feeding area, only up to 300 ha have (so far!) been reserved for gravel digging, so that about 1600 ha will remain, among which 431 ha have the status of nature reserve.

The greatest threat to the up to 15 000 geese (mainly *A. albifrons*) wintering here in the last few years comes from agriculture. To provide food for the excessive animal stocks of the farms, which nowadays are almost factories, more and more pastures are changed into arable fields, especially maize fields, which means that geese are more and more deprived of their feeding base. Even in nature reserves this development occurs.

4. The last 10 km of the Rhine in Germany, from Emmerich to the Dutch village of Milligen aan de Rijn, are bordered by nature and goose reserves, with a total area of 4813 ha. It would seem that there is here a perfect example of how to carry on nature conservation, a Shangrila for up to 30 000 geese. But sadly, this is a somewhat premature assumption. All areas and regulations, which are important for nature conservation but which could give rise to conflicts with economic interests, are left out in advance. So in-

stead of a big, ecologically efficient, continuous goose reserve, this refuge has become a mosaic of protected and non-protected areas. Moreover, the ecological value of the protected areas is constantly reduced, for instance by the building of a federal highway (the so-called "new B 9") just outside the protected zones, and by the almost complete absence of regulations to reduce human activities in the reserves themselves. So more pastures are changed into fields for winter grain, sugar beet and maize every year. Although from an agricultural point of view the process has been proved totally inefficient, a lot of pastures are sprayed with liquid manure every winter and thus provide no food for geese, and some hedges are spirited away every year.

Goose prospects in the Lower Rhine wintering area

The overall picture in the coming years in the approximately 15 000 ha of potential and actual feeding places for an increasing wintering population of geese (about 70 000 in winter 1980/81) situated on the banks of about 90 km of the Rhine between Duisburg and the Dutch – German border, may be as follows:

1. 3000 ha (20% of the total area), mainly in the southern part of the region, will be lost to industry and recreation, without any legally prescribed compensation; and
2. 6900 ha (about 46%), mainly in the northern part of the wintering area will be under the negligible protection of "nature reserve" status, with only a few restrictions for users, although the law (Bundesnaturschutzgesetz Articles 10, 12 and 13) gives the state governments powers to make conditions for the exploitation of nature reserves.

This development will cause a concentration of wintering geese in the northern part of the wintering area, i. e. in the border region.

Because of the specific problems of goose protection and of nature conservation in frontier regions generally, the only way to promote effective nature conservation, and thereby to make protection for geese really effective, is at international level. Although there are many good intentions and many international conventions have been made with a number of small results, the fact is that international cooperation is still more talk than action. As the German biologist *Erz* (1980) wrote: "What is absent, is the action: the realization of existing legislation. The insufficient execution of legislation is the unsolved problem of nature conservation". (Translation *J. H. Mooij.*)

In the author's opinion it is the duty and mission of international organizations such as IWRB and WWF, not only to promote research, but to put pressure on governments to take nature conservation as seriously as economy. Because if we do not induce action now, we will, in a few years' time, have nothing natural left on which to do research!

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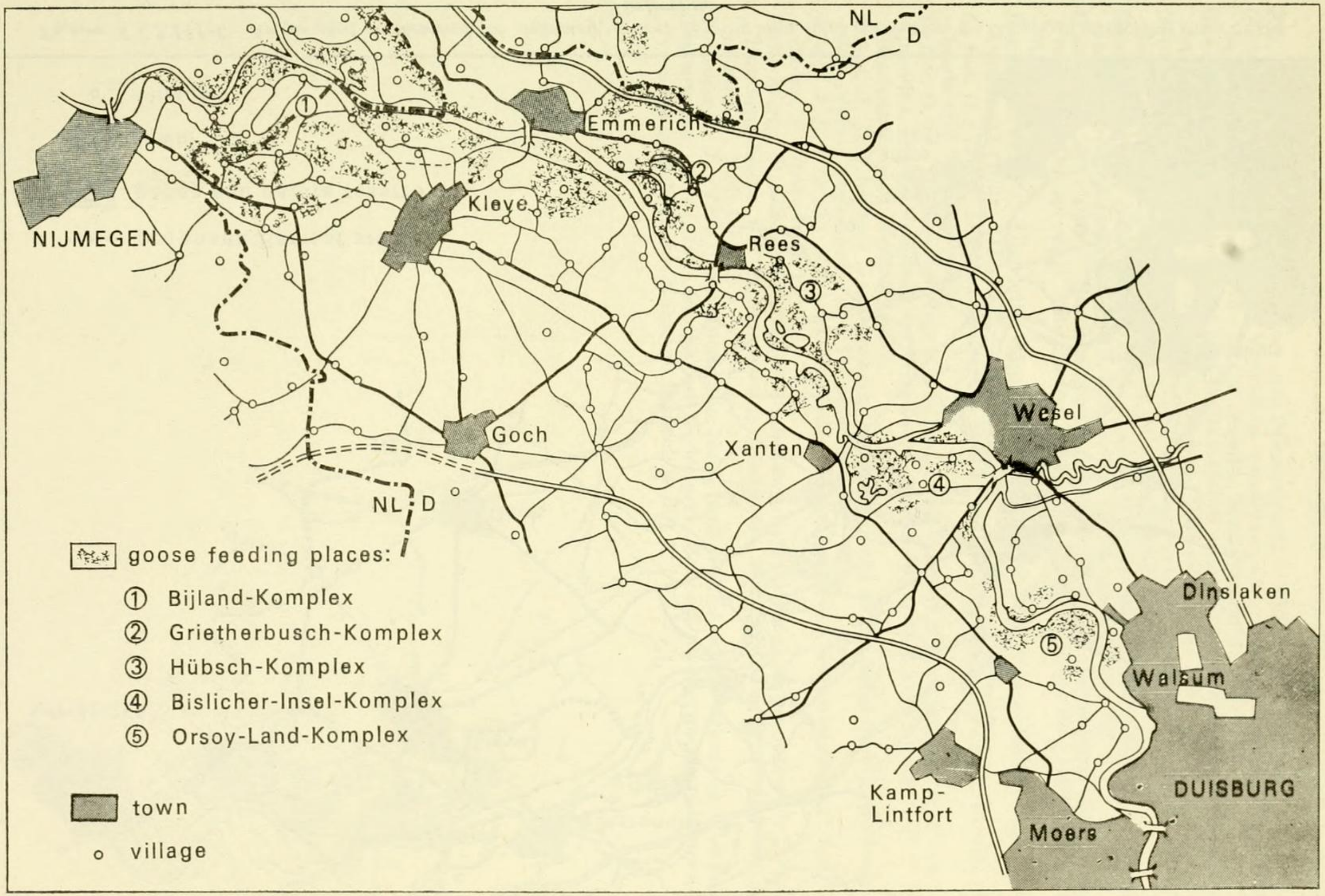

Figure XXXIII/5: Existing and planned natur and goose reserves in the "Niederrhein" area

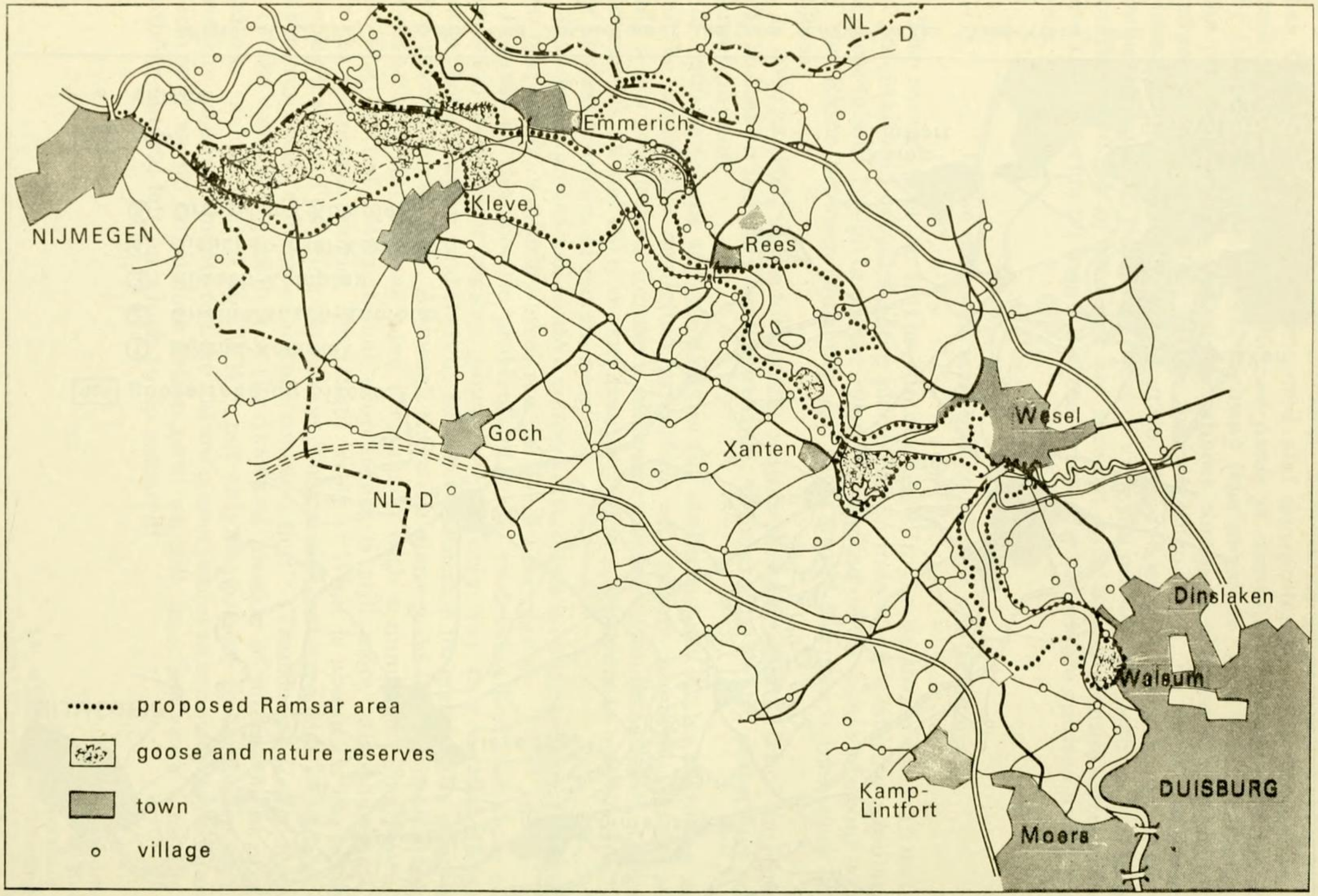

Figure XXXIII/6: Areas used or planned for industry, gravel digging and loud recreation in the goose wintering area at the Niederrhein

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XXXIV. INFLUENCE OF HUNTING ON THE *ANSER ANSER* POPULATION IN FINLAND

T. Lampio

Introduction

Opinions concerning the effect of hunting on game populations are markedly divided. Recent American studies have emphasized the compensatory character of hunting mortality and explained that natural mortality is, at least to a certain degree, inversely proportional to the intensity of hunting mortality (see *Anderson* and *Burnham* 1976 and *Rogers et al.*, 1979). This viewpoint has been shared also by some European experts, and partly also the author. There are many others, however, who believe that shooting has a stronger or slighter effect on the populations, dependig on the intensity of hunting. Numerous examples of the effect of heavy shooting on non-migratory game populations in particular indicate a clear influence of hunting on the abundance of the populations. Hence, we hardly can consider this problem completely settled, but additional information is highly desirable in this matter.

Examination of the effects of hunting on migratory waterfowl is usually rather difficult, as differences in the intensity of shooting and varying hunting regulations in different countries easily obscure the picture. Yet the *A. anser* situation in Finland may throw some additional light on this problem, as different shooting policies have been applied in different parts of the Finnish range of *A. anser*. As there are no evident differences in other factors capable of producing the differences found in the Finnish *A. anser* population, there is good reason to examine the situation in more detail.

Abundance fo the A. anser in the 1950s.

The Finnish distribution of *A. anser* is characterized by the domestic name of the species, the "Sea Goose". The species occurs in Finland in the southern and western archipelagos and in one small area on the coast only. This has been the distribution of *A. anser* in Finland at least since the end of the last century. In the first half of the present century the population experienced a drastic crash, which took place in all parts of its range.

It is important from the point of view of this study to examine the goose situation in the 1960s, i.e. prior to establishing the differences in shooting policy in 1960. According to Merikallio (1955), the whole Finnish population of *A. anser* then consisted of 130 breeding pairs distributed as follows: 3 pairs in the Gulf of Finland, 20 pairs in the southwestern archipelago, 5 pairs in Merenkurkku and 100 pairs in the northernmost part of the Gulf of Bothnia.

Grenquist's (1956) estimate of the Finnish breeding population of *A. anser* was based on somewhat more recent material and was a good 200 pairs. According to him, more than 50 pairs were found in the southwestern archipelago and adjacent areas, whereas the population in the northernmost Gulf of Bothnia consisted of 150 pairs.

There is no doubt, thus, that the principal Finnish *A. anser* population was found in the 1950s in the northernmost part of the Gulf of Bothnia, where three quarters of the total population was breeding. One quarter only was met with in the southwestern archipelago and adjacent areas.

Hunting regulations

The shooting season for *A. anser* has varied in Finland at different times. The end of the open season has no practical significance, as the species leaves the country in August and early September. The opening dates at different periods were as follows: 15 July (from 1868), 1 August (from 1895), 15 August (from 1923) and 20 August (from 1934).

Due to a strong decrease in the population the species was protected in 1947 throughout the year in the whole of Finland. The Ministry of Agriculture was authorized to grant licences for *A. anser* hunting, which however took place in rare cases only.

In 1960 the policy was changed again, as the goose population had started to increase. Shooting was started now on 20 August at 1200 hours, but the species remained fully protected in the southern and southwestern provinces (Turku and Pori, Uusimaa and Kymi). In 1963 goose hunting was started, also in these provinces but only on 15 September when the *A. anser*, practically speaking, has already left Finland. The idea of the new regulation was to allow *Anser fabalis* hunting also in the southern and southwestern areas but keep *A. anser* protected in this region.

In 1969 the opening date was changed to 10 September in the southern and southwestern provinces, the province of Vaasa included. In 1976 the opening date was changed to 1 September, which date is still valid.

In the province of Oulu, where the main proportion of the Finnish *A. anser* population was breeding, goose shooting has begun on 20 August every year since 1960. According to the information collected in 1981, the number of *A. anser* bagged annually in recent years in this province is 60 to 70, which is a good 10% of the local autumn population. The number of *A. anser* bagged in the whole of Finland is unknown, as *A. fabalis* is also open to shooting in Finland and the species are not reported separately in the kill statistics.

Effects of the different hunting policies

It is of interest to examine what effects, if any, are to be found after 20 years of differing hunting policies, which have meant more or less normal harvesting in the northernmost breeding area but nearly complete protection in the southern and southwestern areas.

According to *Blomqvist and Tenovuo* (1980) and *Tenovuo* (pers. com. 1981), the population of *A. anser* in the southwestern archipelago consisted in the early 1980s of 150 – 220 breeding pairs. In other southern and southwestern areas, Åland included, there were 30 – 60 pairs (*Lampio*, in press). Thus the southwestern population had increased roughly six-fold since the 1950s.

According to censuses carried out by the author and his coworkers in the northernmost breeding area in the Gulf of Bothnia, the breeding population in

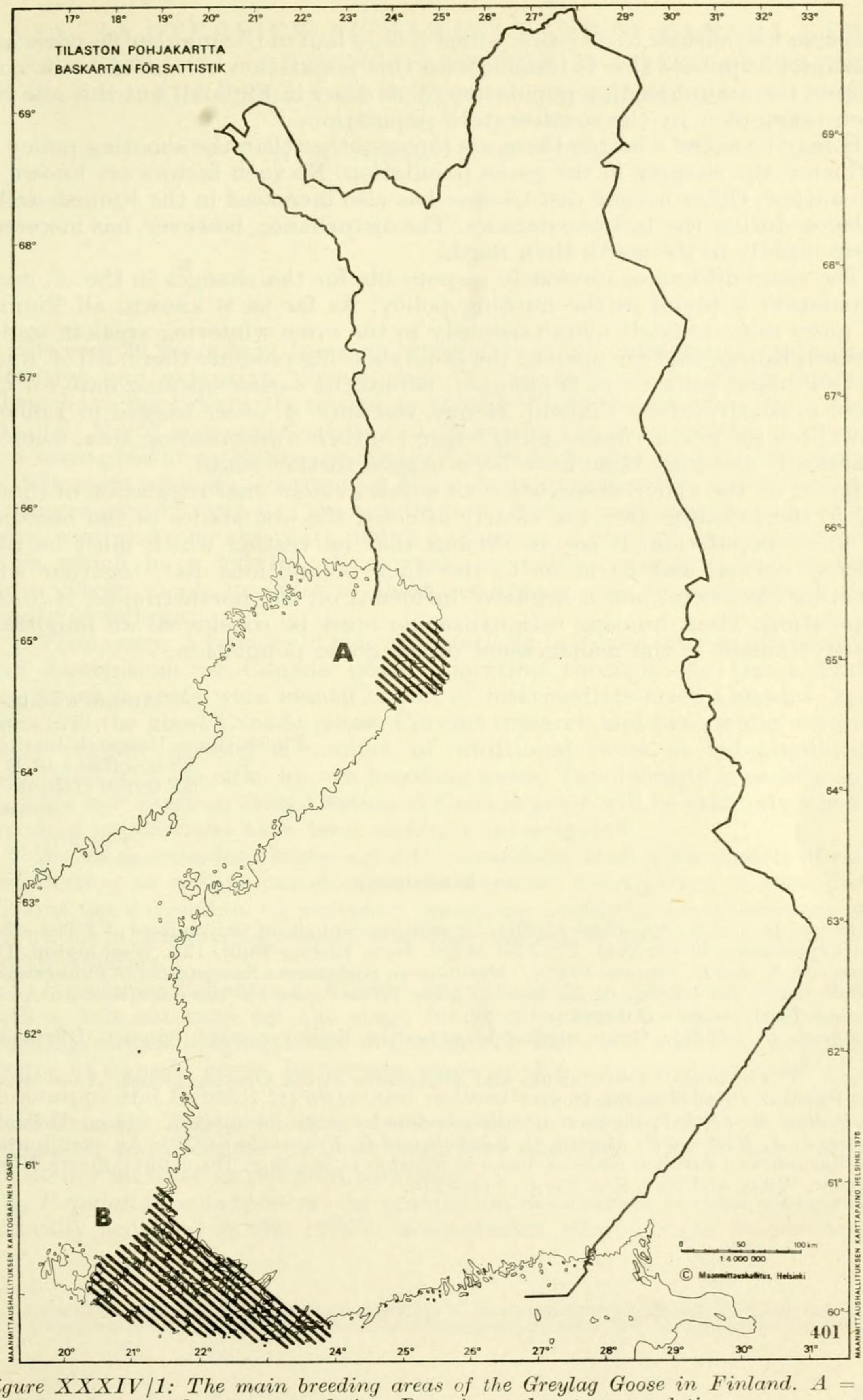

Figure XXXIV/1: The main breeding areas of the Greylag Goose in Finland. A = the northernmost population. B = the southwestern population this area had shrunk to 60 pairs, which is only half of the number 20 years ago (*Lampio*, in press). Due to the decrease this population can no more be considered the main breeding population of *A. anser* in Finland, but this role has been taken over by the southwestern population.

It may be asked whether there are factors other than the shooting policy to influence the changes in the goose population. No such factors are known to the author. Other human disturbance has also increased in the Finnish archipelagos during the last two decades. The disturbance, however, has increased more rapidly in the south than north.

The main difference obviously responsible for the changes in the *A. anser* population is found in the hunting policy. As far as is known, all Finnish *A. anser* migrate fairly simultaneously to the same wintering areas in southwestern Europe and are open to the same shooting pressure there. All *A. anser* leave Finland prior to 15 September, before the earlier opening date for the geese in southwestern Finland. Hence, the only *A. anser* bagged in Finland have been the northernmost birds bagged in their own breeding area, whereas practically speaking none have been bagged further south.

Based on the above observation sit seems evident that regulation of shooting in the breeding area has clearly affected the abundance of the breeding *A. anser* population. It seems obvious that harvesting which must be considered normal and harmless to the duck populations has, together with shooting elsewhere, had a negative influence on the northernmost *A. anser* population. Thus, hunting rationalization must be considered an important positive means in the management of the goose population.

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XXXV. AN OVERVIEW OF MANAGEMENT OF CANADA GEESE *(BRANTA CANADENSIS* AND THEIR ADAPTATION TO SUBURBAN CONDITIONS IN THE USA*

H. K. Nelson–R. B. Oetting

The past 30 years have been punctuated by many outstanding examples of intensive and extensive management of Canada geese in North America. These have been correctly touted as wildlife management successes without parallel. Major accomplishments can be attributed to a variety of research and management activities conducted by the U. S. Fish and Wildlife Service (FWS), state agencies, universities and private organizations and individuals.

Even a cursory review of the hundreds of Canada goose reports and publications, compiled over the years, shows a sequence of research and management steps which have led to our current, incredible understanding of these birds. These steps, in order of their occurrence, can be categorized quite simply as follows:

1. *Taxonomy:* Advances in this area initially involved studies of speciation and descriptions of Canada geese migrating through the Great Plains. Important aspects were identification of intermediate-sized Canadas, small races and the giant Canada goose. Current research and taxonomic work will likely suggest naming a number of additional races or sub-populations associated with specific, known breeding areas. Taxonomists generally agree that the last word on identification of Canada geese will be said only when all breeding populations have been carefully investigated.

2. *Racial distribution:* Many notable researchers dealt with aspects of racial distribution as well as taxonomy since accurate descriptions of such distributions are dependent on accepted taxonomic designations. Important contributions in this category have come from studies of Canada geese throughout North America.

3. *Population delineation:* Closely allied with taxonomy and racial distribution, this category set the stage for management by describing known breeding ranges, staging areas, migration corridors and wintering grounds of groups of Canada geese. Important work in this area involved geese of the Mississippi and Central flyways and delineation of populations of large and small Canadas. Today, 15 races of sub-populations of Canada geese have been delineated and accepted by most waterfowl biologists. The number will undoubtedly increase as research continues.

4. *Population management:* As population delineation became clearer and generally accepted in the 1950's, management efforts began to ensure ad-

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* A modification of a similar paper prepared by Harvey K. Nelson and Robert B. Oetting, U. S. Fish and Wildlife Service, which was presented at the Fourth International Waterfowl Symposium, New Orleans, Louisiana, January 30, 1981.

equate migration and wintering habitat and harvest control throughout the range of known populations. This led to additional state management areas and national wildlife refuges. Important research and banding efforts on the Mississippi Valley and Eastern and Western Prairie populations provided clues to intensive management techniques.

5. *Co-operative programs:* Through this era many new management philosophies and techniques were developed; some succeeded, some failed. The significant feature that evolved was a strong co-operative relationship between state, provincial and federal agencies in the U. S. and Canada and through the flyway councils to carry out management and research activities on a priority basis. A U. S. position emerged whereby the states concerned with management of a given population of Canadas played the principal roles in local management and development of regulations and harvest quotas. Co-operative funding permitted increased research on the breeding grounds. The minutes of Flyway technical committees and councils document these actions.

6. *Restoration and introduction:* While more intensive management of the known wild migratory populations of Canada geese was progressing, increased attention was being given to establishing breeding populations in the northern tier of states and in southern Canada. Trial and error transplants and introductions over the period 1935 – 65 showed that giant Canada geese were best suited for such adventures. While much of the early work took place on national wildlife refuges and state areas, many of these introductions were also successful in cities or suburbs and subsequently led to considerable local problems with the prolific birds.

A look at total Canada goose numbers and harvest in the U. S. in the past two decades shows nearly parallel increasing trends. Total midwinter populations have risen from about 1.2 million birds in 1959 to 2.4 million in 1979. The annual harvest rose from slightly over 400 000 birds in 1959 to over 1 million birds in 1979.

Canada has also had considerable management success with Canada geese. Let's look at one example. In Manitoba, shortly after the 10 000-acre Oak Hammock Marsh Wildlife Management Area came to full water supply level in 1974, staging goose populations rose from 2500 to 240 000 Canada geese and snow geese. Mallards and pintails staged there at the 100 000-bird level where previously only a few hundred could be counted. This waterfowl irruption in the heart of the wheat and barley country of Manitoba's Interlake region was met with varying comments. "Amazing," said the provincial, federal and Ducks Unlimited biologists and engineers who had planned and built the management area. "Great," said the hunters and naturalists. "Intolerable," said adjacent farmers when those immense flocks began depredating grain fields. And, "never again," Manitoba's political leaders said when, in 1976, those masses of waterfowl flew south with more than $ 165,000 worth of wheat and barley in their bellies. Today, managed hunting and lure crop programs at Oak Hammock are holding depredation losses to acceptable levels.

But management success with these birds is not always related to restoration of huge populations. We'll be eminently successful, for instance, if we can continue to bring the Aleutian Canada goose back *(Branta canadensis leucoparia)* from the brink of extinction over the next decade. Meanwhile, a nagging management challenge in the U. S. has been to discourage Canada geese from wintering north of traditional areas. In this regard, our successes at getting Canada geese to find and use mid-continent and southern refuges during their migrations have been tempered by their reluctance to move far enough south in some instances. New management plans and actions are now designed to restore wintering Canada geese to their former southern winter ranges.

Management successes with Canada geese have come about largely because the birds themselves are biologically manageable to a high degree. Their homing instincts and strong migration, breeding, wintering and staging tradition, coupled with their aggressive and prolific breeding behavior play important roles in our ability to manage them. Beyond this, the relative sanctity of their breeding and wintering areas, our concern for overkill and resulting stringent harvest regulations and our habitat management capabilities add greatly to manageability of these birds. And, they are relatively easy to study, though those hardy biologists toting packboards of gear across the cold, roadless, polar bear-infested tundra at Cape Churchill and other northern breeding areas might disagree.

But in spite of these efforts . . . in spite of all we've done with and for Canada geese and all that has been learned and published, we still have only the mistiest knowledge about the many Canadas that grace our cities and suburbs; how many are there, where are they and what do they do? And we know little about how these birds are used by masses of urbanites. In our opinion, urban Canada geese are one of our hardest used migratory waterfowl resources and one of the least studied and managed.

So far, our management of urban Canada geese (primarily the giant Canada goose, *Branta canadensis maxima*) has been like the fighting of wildfires . . . unplanned and reactive. Urban Canadas, viewed by thousands of people and harvested, where restrictions allow, by thousands of hunters, have been dubbed nuisances and pests. Management has consisted largely of uncontrolled introductions and attempts to reduce populations by trapping, relocation, nest and egg destruction, relaxation of hunting regulations and even sterilization. Meanwhile, urban and rural groups have become polarized in many parts of the country due to airport hazards, crop depredation, fouling of lawns and golf courses and contamination of water supplies versus sheer love for the birds by the public.

The problem is usually seen as simply too much success . . . too many Canadas in the wrong places. But the real problem may be too little management attention by federal, state and city biologists and administrators. Wildfire fighting is always frustrating but we've learned that prescribed, controlled burns are gratifying and productive. We must parlay this philosophy into positive management of urban Canada geese.

While our information on urban Canadas is grossly incomplete, it is clear from field reports that this resource is immense and growing. We've got urban Canadas in many of the major metropolitan areas in northern U. S. and southern Canada.

In Minnesota, where we have studied local stituations more closely, there are urban flocks at 20 or more cities, including the metropolitan areas of Minneapolis and St. Paul. The Minnesota urban Canada goose resource is estimated at 30 – 40 000 birds not counting the migrant flock of about 25 000 that also winter at Rochester, Minnesota. Some of these birds winter in Minnesota, some breed in Minnesota, some always migrate, some do when they have to, some don't at all.

While precise population estimates are not available for the total of North America's urban Canadas, undoubtedly they number in the hundreds of thousands if we consider both migrant and nonmigrant flocks. There is little doubt that these urban populations of Canada geese will continue to expand if public agencies and private organizations are willing to bear the cost and initiate control measures when needed. It is the latter action that has now caused us to pause and reflect on a new set of problems developing with urban goose populations. In numerous cases throughout the U. S. and Canada we may have been too successful and in many instances are unable to control expanding urban Canada goose populations.

The U. S. Fish and Wildlife Service has developed policy for management of urban waterfowl which will be circulated for review and approval when the draft is completed. In addition to possible need for further limitations on releases into the wild, consideration has been given to two major avenues of control. These are what we refer to as production-allowed and production-denied strategies. Under the production-allowed strategy we are seeking expanded or new methods for harvesting annual production down to an agreed-upon limit, on a city-by-city basis. Methods to do this could involve expanded sport hunting (as was allowed in Michigan in 1980), even at golf courses and other suburban areas where local regulations permit. When large-scale removal of birds is necessary, charities might be considered as the beneficiaries. Production-allowed techniques would also involve dispersal and continued relocation of geese to areas open to hunting. Ultimately, however, relocation is a finite solution; there are only so many places to put them, and we are rapidly running out of recipients.

In the production-denied strategy, managers would continue to discourage or destroy production by collecting eggs, limiting nesting habitat or facilities on nesting areas, or developing new and acceptable techniques for preventing excessive reproduction in areas where capture, transplant or hunting is not possible.

We believe that urban Canada goose flocks should be managed primarily by the jurisdictions where they are located with strong public input, together with FWS and state technical and planning assistance, if requested.

An urban flock management plan, with population limits and production control or removal techniques clearly spelled out and agreed to, should emanate from the urbanites where the resource is located. The federal role should be extension-oriented rather than operational and regulatory insofar as possible. Waterfowl managers should make their expertise available to these jurisdictions and be prepared to offer a wide array of imaginative management options. Only in this way will we transform the current urban Canada goose issue into a controlled program that will benefit many interests. In any case, the advent of rapidly expanding flocks of urban Canada geese has added an important dimension to our knowledge of public interests and conflicts over use of waterfowl populations and presents an exciting management challenge to federal, state and city biologists, planners and administrators.

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